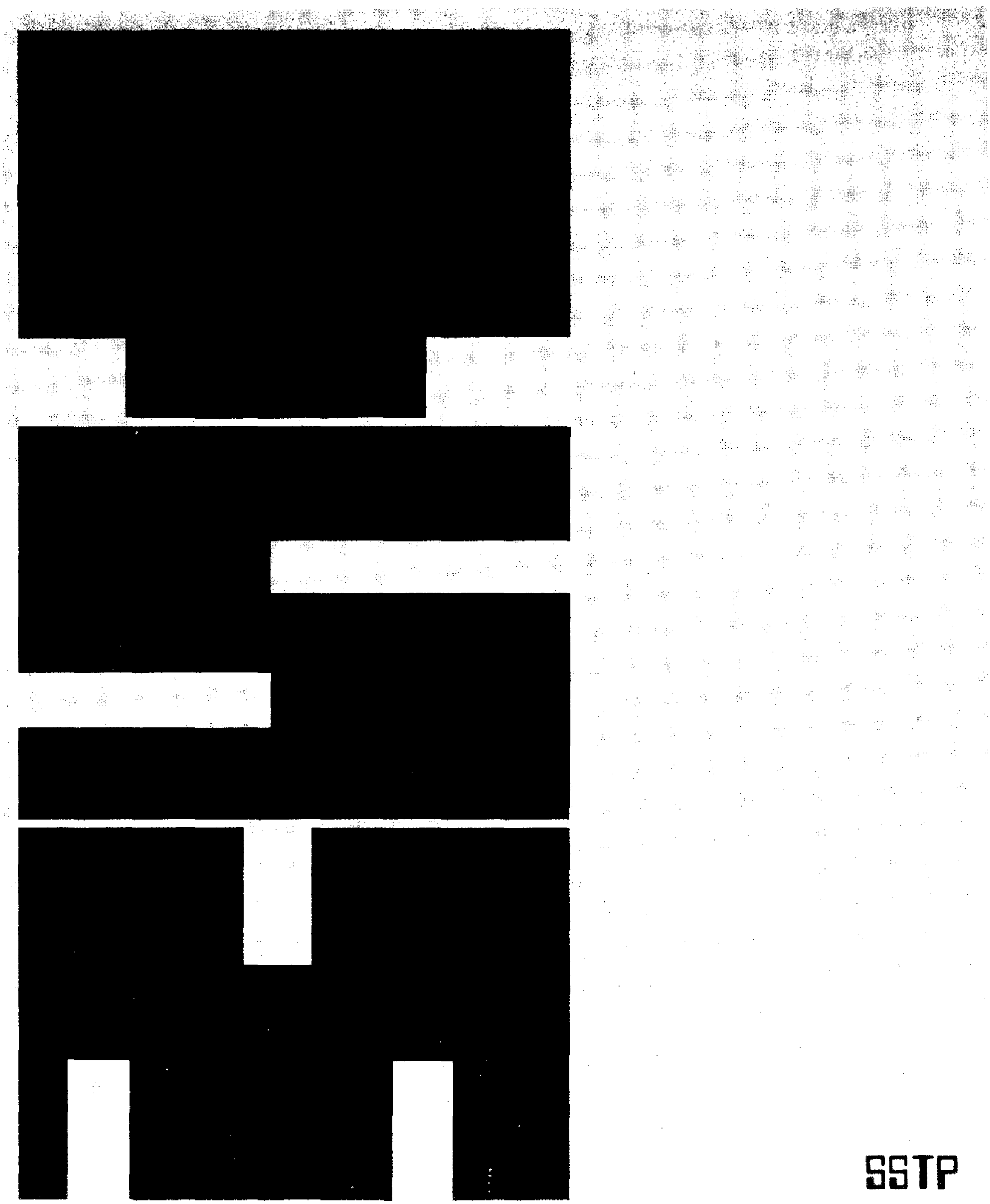
U.S. Department of Transportation

Transportation Systems Management: Implementation and Impacts

March 1982

Case Studies



SSTP

Transportation Systems Management: Implementation and Impacts

Case Studies
March 1982

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I. BARBUR BOULEVARD MEDIAN REVERSIBLE BUS LANE, PORTLAND, OREGON

I. PROJECT DESCRIPTION

A. Capsule Description of Project

The Barbur Boulevard (State Highway 99W) Bus Lane, Portland, Oregon, was begun on September 5, 1978. It was intended to speed suburban express bus operations to downtown Portland and induce a modal shift from cars to buses. It is a 12' median lane on 5-lane (60') suburban arterial, operating 6:30-9:30 a.m. and 3:30-6:30 p.m. At other times the lane functions as a continuous left-turn lane. It is used by 32 outbound buses 4:00-6:00 p.m., carrying 1,500 riders. 5,600 people in 4,000 automobiles and 750 riders in 23 local buses move in two general traffic outbound lanes 4:00-6:00 p.m. on Barbur Boulevard. Funding for the Lane came from the trade-in of Federal Interstate Funds (Mt. Hood Freeway) with State and Local match totaling $608,000 (1978).

Problems encountered with the lane have included accidents, especially at one key intersection, due to motorist confusion over lane and illegal left turns. Bus ridership has slightly declined in the two years after implementation. An average of 1.5 minutes was saved per one-way bus trip. However, most of this was attributed to express operation not the exclusive lane in itself. Agencies involved in the development of this project were: the Oregon Department of Transportation, the City of Portland, and the Tri-County Metropolitan Transit District (Tri-Met).

B. Summary

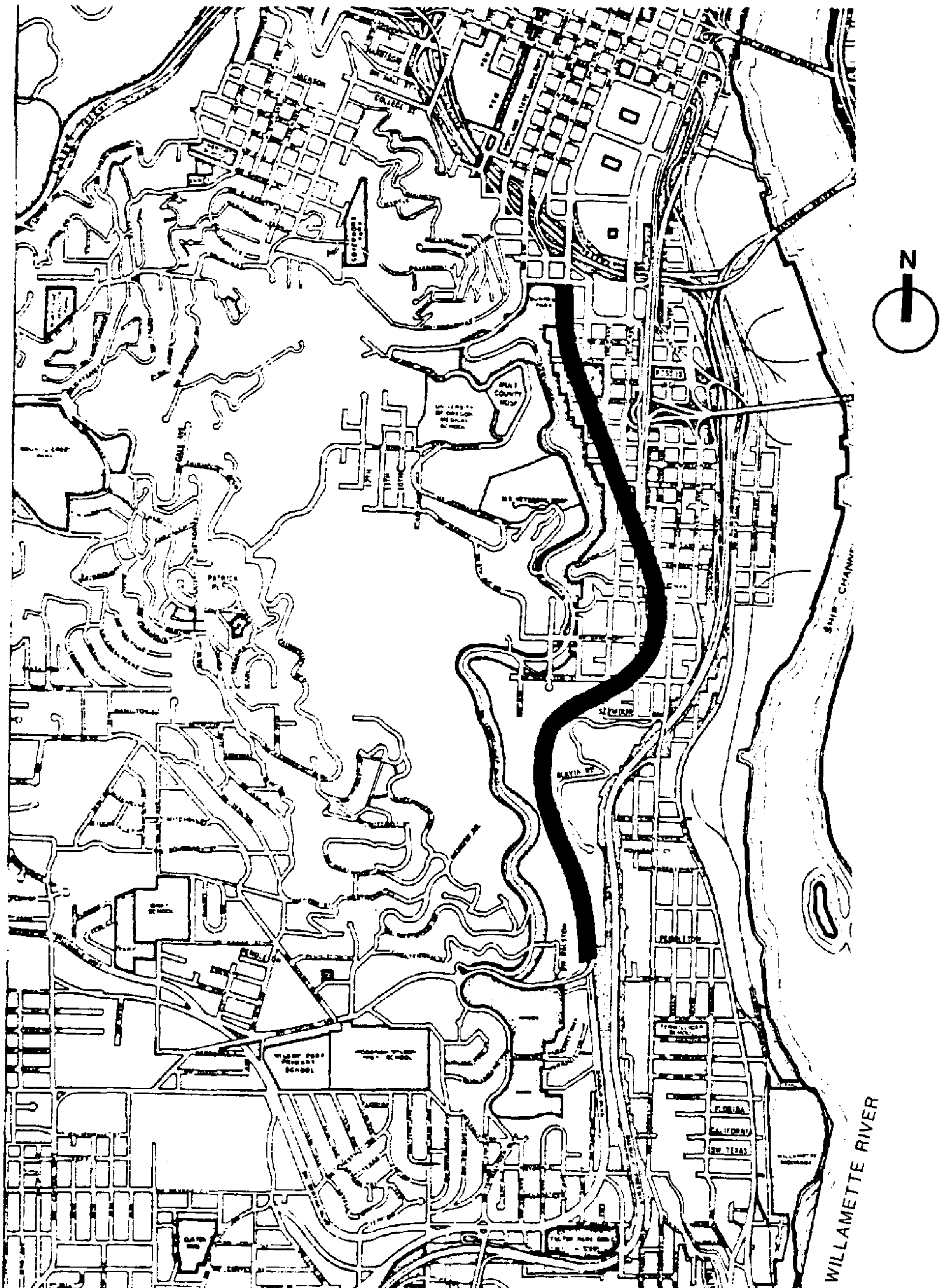
The Barbur Boulevard Bus Lane is the center lane of Barbur Boulevard (State Highway 99W) which runs approximately 1.8 miles linking the southern outskirts of the Portland CBD to low-density suburban areas to the southwest. Twelve feet in width, the lane is median-reversible. The Lane is identified by double yellow lines with occasional diamonds and signs (see Photograph I-1). The Bus Lane provides an exclusive 1.8 mile right-of-way for about 35 buses running express in morning and evening peak periods. The Bus Lane runs less than half way between the edge of the CBD and the Barbur Boulevard Transit Station, six and a half miles south of the CBD. (See Figures I-1 and I-2).

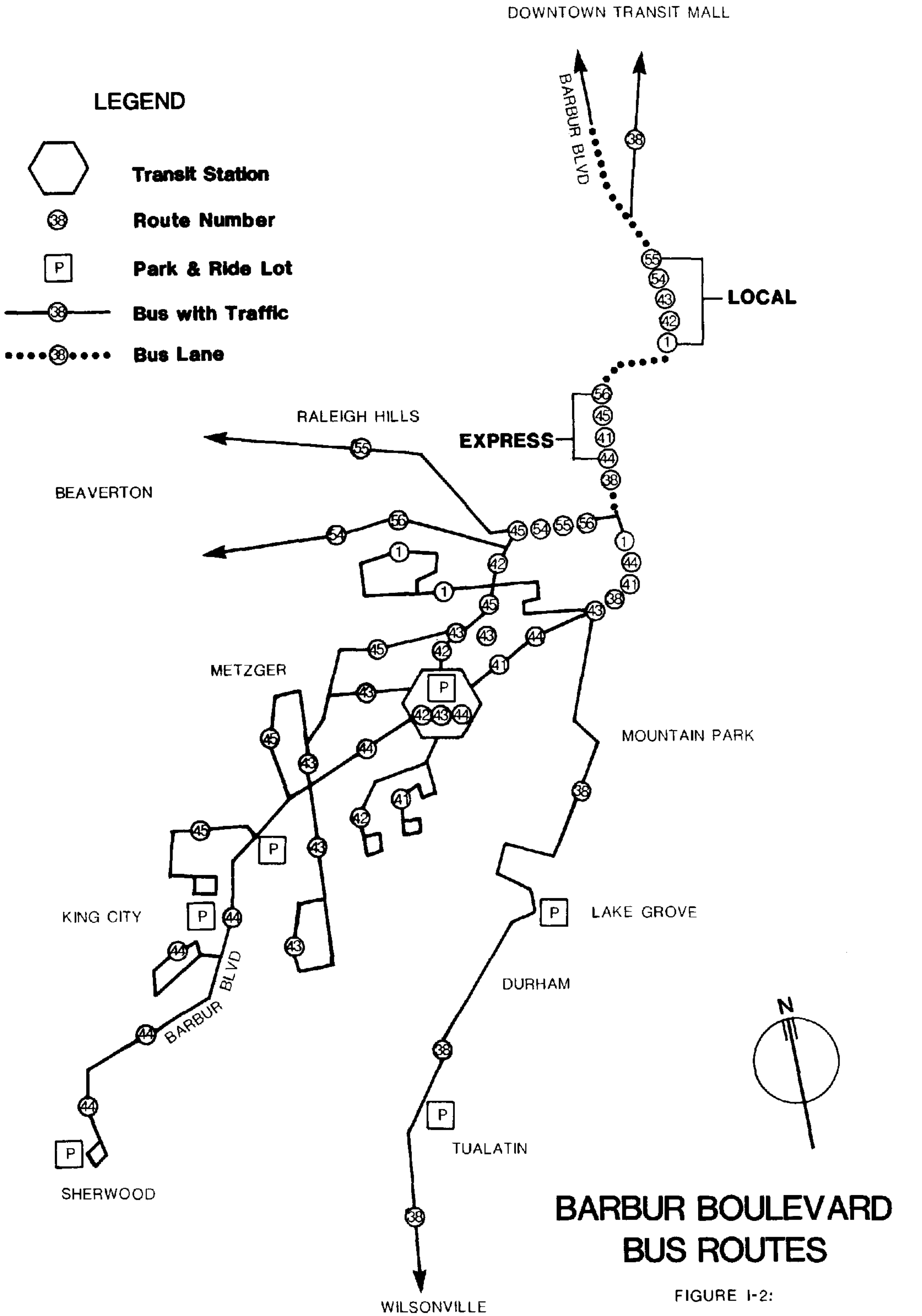
The Barbur Boulevard Transit Station, originally known as the West Portland Park-and-Ride Station, is a large roofed bus station with several bus bays, a large passenger waiting area, secure bicycle parking, benches, lavatories, posted schedules and maps, and a 300-space commuter parking lot. A short loop road provides access for buses to the Station off Barbur

Figure I-1

LOCATION OF BARBUR BLVD. TRANSIT LANE

PORTLAND CBD





BARBUR BOULEVARD
BUS ROUTES

FIGURE I-2:

Boulevard. Originally, it was intended that the Barbur Boulevard Bus Lane run all the way to the Transit Station, which is located along Barbur at its junction with the Capitol Highway and Interstate 5 (Baldock Freeway). Such an extension has been indefinitely postponed as it was found to be prohibitively costly. One of the five bus routes operating on the Bus Lane stops at the Transit Station as do three of the five local buses, operating with general traffic on the curbside lanes of Barbur Boulevard. The Transit Station acts as a bus transfer point and park-and-ride facility at the edge of Portland.

The Bus Lane, which opened September 5, 1978, was tied to the creation of the Transit Station, which began operation a year earlier (August 15, 1977). Planning for the Lane grew out of the West Portland Park-and-Ride proposal, which itself was spawned in the comprehensive long-range planning for the Portland metropolitan area.

Since its inception the Bus Lane has been a useful experiment which somewhat reduced the running time for express buses. However, concerned public agencies in the Portland area have been disappointed in the Lane for two reasons:

1. a higher-than-anticipated accident rate involving motorist confusion over the Lane; and

2. no growth in bus or rider use of this facility in its first two years of operation.

II. PROJECT BACKGROUND

A. Portland Metropolitan Area Planning

The planning which led to the creation of the Barbur Boulevard Bus Lane grew out of the need to influence the form and direction of future land use development in the Portland area.

Typical of the national pattern, Portland's inner city population ceased to grow in the 1960's and 1970's, while its suburban and exurban satellite communities witnessed great expansion. Between 1960 and 1970 the City of Portland's population grew from 373,000 to 382,000 (the slight increase occurring in the outlying suburban areas annexed by the City). During the same period the suburban ring around Portland[1] grew from 449,000 to 625,000, or 39 percent.

There was concern that Portland would go the way of blighted inner cities elsewhere in the country. Quality of life issues - air pollution control, historical conservation, neighborhood cohesion, and transportation access without automobile saturation - also have had a great influence on planning decisions. Portlanders were noticing - with some alarm - strange new glass and steel towers sprouting up in the southern extension of the CBD while hobos lined the sidewalks of the city's old Victorian downtown. Between these extremes was a thriving CBD, which Portland sought to preserve. With the growth of population in Oregon's suburbia, many more automobiles crowded Portland's streets. Work and shopping trips had become longer range and were made by automobile. Portland's streetcar-era radial avenues were not carrying streetcars anymore and bus transit service was declining. It became clear that the sheer physical expansion of the metropolis as well as the shift to the automobile mode would require much more space devoted to freeways, roads, and parking areas. Such spatial expansion of transportation facilities could not take place in Portland without painful alteration of the city's life and a greatly reduced role for its small downtown core.

Public agencies in the Portland area have responded to these concerns with a number of policies begun in the 1970's. Generally, they have sought to preserve Portland as an attractive, pollutionless place in which to live and are determined to maintain the downtown as a thriving, concentrated commercial center. Reducing automobile use by inducing auto riders to switch to mass transit has been perceived as high priority and

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[1]Defined as the Portland Standard Metropolitan Statistical Area (SMSA) <u>exclusive</u> of the City of Portland - Clark County, Washington; Clackamas and Washington Counties, Oregon; and Multnomah County, Oregon minus Portland.

given strong encouragement. These policies and their implementation have met with national recognition, contributing to Portland's Mayor Neil Goldschmidt's selection as Federal Secretary of Transportation in the Carter Administration. For convenience, Portland area planning policies are described here as they relate to four basic sets of plans: the City's Comprehensive Plan, the City's Transportation Control Strategy (TCS), the existing Tri-Met Transit system, and the 1990 Public Transportation Master Plan and its revisions.

1. The City of Portland Policies

This has included a host of measures to preserve the "liveable" city enhancing transit, community participation and the environment. The City expanded its Planning Bureau and created a new Office of Neighborhood Associations with its own field offices and semi-official neighborhood associations. There are now limitations on auto parking, floor/area ratios in buildings, new construction, commercial and residential density and land use, off-street parking requirements, and developments in historical, air quality-sensitive, or park-deficient areas as part of the City's Arterial Streets Classification Policy, its Downtown Parking/Circulation Policy and other policies. Much City land is devoted to parks.

The City's Comprehensive Plan calls for "...maintaining this basic development pattern..." of a strong downtown with fairly dense and close radial corridors: "The proposed land use pattern limits the more intense residential densities to areas which reinforce the workability of public transit. The commercial centers along transit corridors are designed for new land uses which are not highly dependent on the automobile." The Plan calls for "...some increase in density to reduce urban sprawl, increase energy efficiency..."so that"...more people can be closer to existing employment and shopping services, costly urban sprawl can be reduced, and public transit can be more accessible to more people." The plan states as goals: 1) locating labor-intensive work sites and medium and high density housing along transit routes - especially near transit stations and transfer points, and 2) the use of "infill development" to foster utilization of urban land more intensely. Part of the plan specified the development of "transit streets" in transit corridors.[1]

2. Transportation Control Strategy (TCS)

In response to the mandates of the Federal 1970 Clean Air Act, the City of Portland sought to reduce air pollution in its

[1]Portland Bureau of Planning, Portland Comprehensive Plan, October 1980, Portland, Oregon

downtown and other inner city areas. Enhancing mass transit and imposing restrictions on automobile travel and parking availability have been the main focus of the TCS.

The TCS was developed with the Oregon Department of Environmental Quality (DEQ) and the Tri-County Metropolitan Transit District (Tri-Met) in compliance with Federal clean air standards. Part of the TCS was designed to: "Develop exclusive bus lanes where feasible. Consider using reverse-flow lanes at peak hour on such arterials as Barbur Boulevard, Sandy Boulevard, Sunset Highway and Interstate Avenue." A High Occupancy Vehicle (HOV) Lane for buses and car pools has been in operation successfully on the Banfield Freeway in eastern Portland since December, 1975.[1] The HOV lane is planned to be replaced by a Portland-Gresham light rail line paralleling a widened Banfield Freeway. The Barbur Boulevard Bus Lane has been the second major bus priority radial route created in Portland, in large part to fulfill the TCS. In 1980 a ramp metering system with priority for buses and car pools was instituted on I-5 north of Portland.[2]

3. Tri-Met Transit System

The State of Oregon created a publicly-owned mass transit agency to take over all private bus service in the Portland metropolitan area and plan for future transit operations. This agency, the Tri-County Metropolitan Transit District, or Tri-Met, presently operates a bus system unusually large for a medium-sized city and is characterized by an emphasis on marketing. Tri-Met served 149,000 weekday passenger trips in 1980.[3] Figure I-3 shows most of the Tri-Met network.

Tri-Met inherited many radial bus routes going to and from downtown Portland. With the help of government grants and subsidies, Tri-Met had expanded service, created some new routes, upgraded its vehicles and plant, simplified fares and held them down. Tri-Met has also emphasized marketing. The elements of this marketing program have included: distribution of system route map/guides and route schedules, maintenance of a 24-hour-a-day telephone information service, construction of about 660

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[1] P. 15, Portland Bureau of Planning, Status Report on Portland's Transportation Control Strategy, October 1977 (hereafter: TCS, 1977).

[2] P. 15, Project Development Section, Tri-County Metropolitan Transportation District, West Side Corridor Report #8, Transit Network Description, May 1981; Portland, OR (hereafter: West Side Corridor); and Oregon Department of Transportation, I-5 North Freeway Management Improvement Program, April 1979.

[3] Ibid.

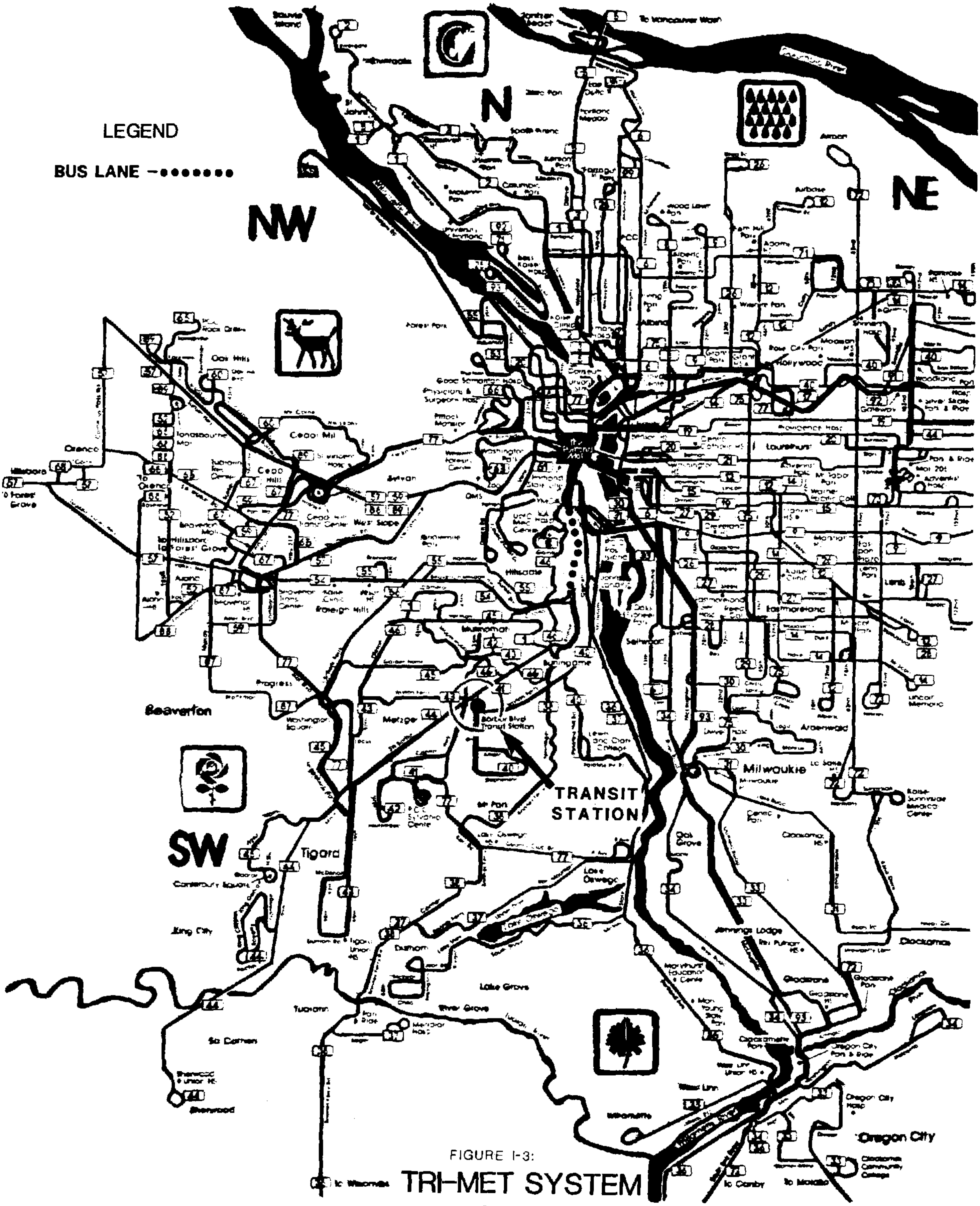

FIGURE I-3:
TRI-MET SYSTEM

bus stop shelters by 1977 (all but 29 within Portland),[1] emplacement of distinctive bus stop signs with route numbers and the telephone information number at nearly all stops, surveying of riders and demographic and economic data to determine where service is needed, and, most significantly, the creation of Portland's largest transit innovation, the Downtown Transit Mall.

The Downtown Transit Mall consists of a ten-block stretch of the one-way couplet formed by 5th and 6th Streets. Automobiles are banned except for a single lane for two-to-three block segments while buses move on the rest of these streets. Sixty-five of Tri-Met's 71 bus routes run on the Mall. These parallel shopping streets are attractively landscaped and decorated with brick crosswalks, plants, street sculpture, and Portland's unique Victorian-style bus stop shelters.

These large shelters are designed to allow passage through the shelter from the sidewalk to the bus door under shelter from rain. Besides providing protection from inclement weather, the shelters function as marketing tools. Each bus shelter in the Mall is a stop for one of seven sets of bus routes serving a sector of the metropolis. Each set of buses is designated by a distinctive color and logo (e.g. yellow rose-Southwest; red fish-Northwest, etc.). The use of symbols, colors, and alternate block placement of sector bus stops makes it very easy for riders to locate their desired bus. Inside each shelter is an illuminated system route map, schedules for all routes of that sector, an information telephone, a computer-run video screen indicating updated route schedules for sector routes and other information.

The Transit Mall provides both an attractive and relatively uncongested urban park, integrated into the CBD, and an open-air linear terminal for the Tri-Met system. Each of the five two-block segments forms a complete set of stops for all 65 routes. All of the CBD is within walking distance of a Mall segment. Bus rides along the Mall or between any points downtown ("Fareless Square") are free - including feeder service to Amtrak and Greyhound. Acting as a labor-free, 24-hour advertising and information service for Tri-Met, the Mall has helped raise Tri-Met ridership and saved the expense of a downtown terminal.

One of the TCS's goals had been to increase daily bus ridership into the CBD from 25,000 (1972) to 37,500. Tri-Met actually exceeded that goal, carrying over 40,000 daily passengers by June, 1975 and over 47,000 by 1977. Over 5,000 free

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[1]Pgs. 12 and 17, TCS, 1977.

downtown rides were also given as part of the "Fareless Square" program.[1]

4. 1990 Public Transportation Master Plan

Many of the elements making up the present Tri-Met system, including the Transit Mall and the Barbur Boulevard Bus Lane, were included in the landmark 1990 Public Transportation Master Plan (1973).[2]

The Plan's traffic projections to the year 2000 show that Portland's highways would be saturated with peak hour traffic and that a large modal shift to mass transit, preferably in exclusive right-of-way, was necessary. The Plan recommended an elaborate and expensive set of projects including several bus lanes, bus malls, park-and-ride lots, light rail lines, and transit stations. While this Plan has proved prohibitively costly to implement and is based on projections from 1970 which are obsolete, it has provided a touchstone for discussion and analysis of the Portland area's transit system by providing a "maximum development" picture. Parts of the plan have been implemented or are still under serious consideration.

The Plan assumed a much greater freeway network and a much larger SMSA population than existed in 1970. Neither prospect was popular in Portland. A City Planning assessment of the Plan was that it tended "...to make a system which was based on, and encouraged, increasing urban sprawl."[3] The Columbia Region Association of Governments (CRAG) has revised the Plan's demographic forecasts and scaled down its capital program to a more modest Interim Transit Plan,which was predicated on a cutback in freeway construction and a policy of supporting existing development and travel corridors. CRAG's thinking, like that of the Oregon Governor's Task Force Report, "The Cooperative Transportation Planning Process in the Portland Metropolitan Area", stressed a slow-growth development policy in Oregon and low capital TSM-style techniques. Both reports favored the implementation of bus lanes.

B. Barbur Boulevard Project Planning

Planning for the Barbur Boulevard Bus Lane was geared toward providing congestion-free access to the Portland CBD from the Southwestern Corridor (I-5 and Barbur). The major

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[1] Pgs. 12 and 17, TCS, 1977.

[2] De Leuw Cather & Company, 1990 Public Transportation Master Plan, San Francisco, CA. 1973.

[3] City Planning Bureau internal memorandum, June 30, 1976, Steve Dotterrer to Douglas Wright, former Chief Transportation Planner (hereafter: Dotterrer memo).

questions to be addressed dealt with the scale of the project, the technology to be used, and the functions and relationships of the major elements of the project - a bus lane, a transit station and a park-and-ride lot.

Planning involved three agencies: The Oregon Department of Transportation (ODOT), the City of Portland Planning Bureau, and Tri-Met. In 1973, concurrent with the 1990 Plan, Portland Mayor Neil Goldschmidt formed a Technical Advisory Committee (TAC) on transit-oriented park-and-ride and bus lane projects. The TAC gave top priority to the Barbur Boulevard project. Because of the small staff of Tri-Met and the City Bureau of Planning, the ODOT assumed most of the work and responsibility for the project. This included: the formulation of the Federal grant application, the Environmental Impact Statement (EIS), and project engineering.[1] Barbur Boulevard from Front Avenue south is a state highway.

1. Traffic Projections

The key factors in the decision to implement the exclusive bus lane on Barbur Boulevard were traffic projections. The 1990 Plan projected Barbur with a peak demand auto volume of 2,430 by 1990 while its capacity at the intersection with Hamilton Street was only 1,700. The other major southwest roadway, Interstate 5, was already considered near capacity at its existing ramps.[2] The projected 100 percent population growth for suburban/exurban Washington County, to the west of Portland, contributed greatly to these traffic projections. The Barbur Boulevard Bus Lane, which carries seven of the fourteen routes linking Washington County to the Portland CBD, was envisioned as a major conduit for this growth. The Barbur Bus Lane was therefore perceived as a way to increase the people-carrying capacity of this corridor.

2. Park-and-Ride

The 1990 Plan envisioned three types of commuter automobile parking lots: Suburban, Intermediate (city edge) and Intercept (CBD edge) park-and-ride lots. City and Tri-Met planners have tended to be against Intercept and most Intermediate park-and-ride lots. Their philosopy is that Tri-Met should generate its own feeder service within City limits, and that long-distance auto access from the suburbs to the "Fareless Square" free zone, or even Zone 2 (inner city), should be discouraged.

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[1]Ernest Munch, former Portland Chief Transportation Planner to M. Cunneen, April 1981 (hereafter: Munch).

[2]1990 Plan; and Portland Bureau of Planning, South Portland Circulation Study, June 1978, Portland, OR.

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While the 1990 Plan had proposed 800 spaces for a West Portland park-and-ride lot at Barbur Boulevard's junction with Capitol Highway and Interstate 5, City planners felt 300 spaces, not 800, would suffice to serve the nearby population. They felt additional spaces would attract riders from suburbs further out in Washington and Clackamas Counties. City planners did not want to reduce land area available for community development. The plan for 300 spaces was made with the foreknowledge that the lot would fill up shortly after it was opened. It was hoped that access to suburban buses could be provided by foot or by auto to suburban park-and-ride lots.

3. Transit Station

The 1990 Plan had recommended that a Transit Station be built on the same site as the West Portland park-and-ride lot. The Station would serve as a sheltered waiting area for park-and-ride patrons and a bus transfer point for the Southwest Corridor. The Station and its park-and-ride lot were to be owned and operated by Tri-Met.

City planners wished to emphasize the station aspect of this dual transit station/park-and-ride facility. Rather than creating a conveniently placed parking lot with short headway bus service to downtown, they envisioned the Station as a node linking a growing medium-density satellite community to the Portland CBD. The planners' objective was to integrate the Station with high and medium-density housing and commercial development so as to encourage a large walk-in patronage much like a typical light rail station. To these ends, City planners incorporated a pedestrian/bicycle bridge over I-5 from the Huber Street neighborhood to the Station. This community had been cut off from the Barbur/Capitol commercial node by I-5's construction in the 1950's. Bicycle parking and pedestrian amenities were included as part of the Station's design.

It was also intended to increase local bus service to the Station, making it an important transfer point. It was proposed to re-route the circumferential #77 (originally #78) bus route (Lake Oswego to Beaverton), which began in January 1975 and went through Portland Community College (Sylvania), two miles south of the Station site. "The possibility of transferring to reach the largest number of destinations thus became an important objective of the project in addition to fast service to the downtown."[1] CRAG's Recommended 1990 Bus Rapid Transit System listed seven lines which were proposed to pass through the Station site. Bus routes, before and after implementation, are shown in Figures I-4 and I-5.

The issue of appropriate scale was a major component of the planning. While the prohibitive economics of a new light rail line in the Southwest Corridor ended any interest in laying tracks, the ODOT had to reject the original architect's grandiose design for the Transit Station, which contained accmomodation for future monorail installation.[2]

4. Bus Lane Length

The greatest scaling down of the project was in its length. The original proposal was to extend the Lane all the way to the Transit Station. However, establishment of a median bus lane south of Slavin Road would be very expensive, requiring the rebuilding of two four-lane bridges and numerous intersection changes. This southern section of Barbur Boulevard was also a commercial highway strip of unlimited access, lined by a hundred establishments - restaurants, motels, gas stations, stores and car dealers. Loss of left turns during peak periods might have been a considerable problem for these businesses, their employees and shippers. Only one of the five suburban routes (#44) planned to run express on the Bus Lane ran on this southern segment. Had the Bus Lane express operation been extended all the way south to the Transit Station and the #44 not picked up local passengers, only the local #41 would pick up riders along this southern segment of Barbur and headways would triple.

It was also felt that the Bus Lane would serve a lesser function on the southern segment. Both bus and automobile volumes there were about half what they were on the northern segment. ODOT 1978 traffic counts show average 24-hour weekday traffic on the northern segment of Barbur Boulevard - the segment which contains the existing Bus Lane - as 33,500 vehicles between Hamilton and Sheridan. Traffic volumes on the southern segment of Barbur, between the terminus of the Bus Lane at Slavin and the Transit Station, were between 14,000 and 18,500 with 16,500 recorded nearest the Station.

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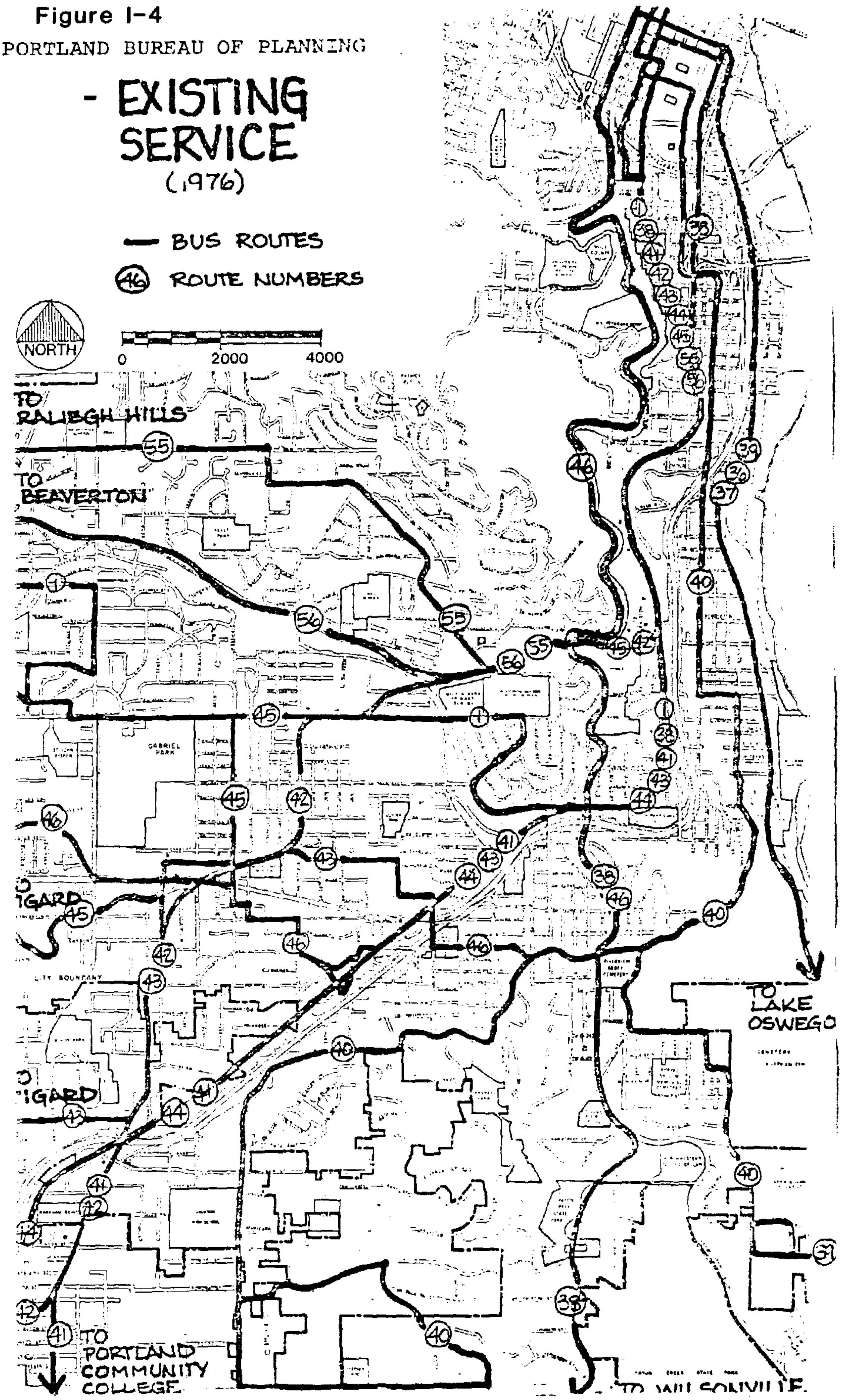
[1] P. 48, Oregon Department of Transportation, West Portland Park and Ride, Final Environmental Impact Statement, Salem, OR. (hereafter: EIS).

[2] Munch.

Figure I-4

PORTLAND BUREAU OF PLANNING

- EXISTING SERVICE (1976)



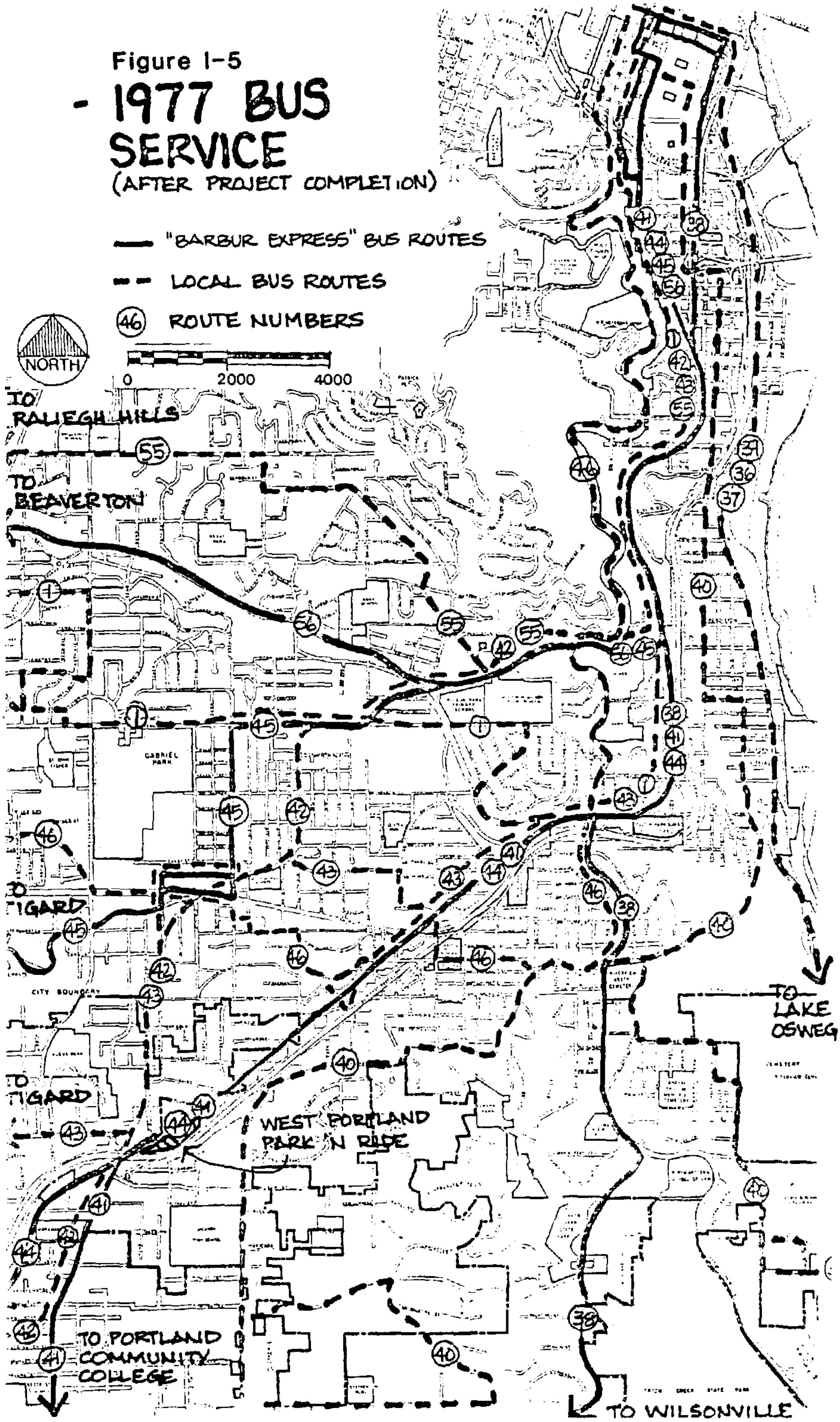


Figure I-5
- 1977 BUS SERVICE
(AFTER PROJECT COMPLETION)
"BARBUR EXPRESS" BUS ROUTES
LOCAL BUS ROUTES
ROUTE NUMBERS
NORTH
0
2000
4000
TO RALIEGH HILLS
TO BEAVERTON
TO TIGARD
TO TIGARD
WEST PORTLAND PARK 'N RIDE
TO PORTLAND COMMUNITY COLLEGE
TO LAKE OSWEGO
TO WILSONVILLE
GABRIEL PARK
CITY BOUNDARY

For these reasons the idea of extending the Bus Lane south of Slavin Road was dropped in favor of the more cost-effective and easily implementable northern segment. The 1.8 mile northern segment had only a few commercial enterprises along it, would carry more buses through heavier traffic, and did not require costly bridge widening. While the estimated 1974 cost of the full 5.5 mile Bus Lane to the Transit Station was over $2 million,[1] expenditures necessary to extend the present Bus Lane another 3.7 miles for the southern segment were estimated in 1980 at over double that figure.[2] Development of the existing Bus Lane in the northern segment cost $608,000 (1978 dollars), 86 percent paid for out of Federal Interstate funds by transferring funds originally intended for the proposed Mount Hood Freeway (a project which was withdrawn), with the local match coming from the State and Tri-Met.[3] Construction of the Transit Station, park-and-ride lot, and pedestrian/bicycle bridge cost $2,244,137 (1976 dollars).[4]

5. Community Involvement

Much of the work done by the Technical Advisory Committee was performed in communication with local community groups, which participated in the planning process. Community groups determined the precise site of the Transit Station and contributed several features facilitating pedestrian access which were incorporated into the facility.

An infrastructure of community participation existed in the project area through the City-sponsored Corbett, Terwilliger, and Lair Hill Community Associations, the Jackson (High School District) Community Association, and the network of citizen involvement from the City Planning Bureau's Huber Street Study. In the course of the Huber Street Study, local residents had been surveyed as to how they felt about the establishment of a park-and-ride lot near the Barbur/Capitol/I-5 interchange and were found to favor it. However, there was concern over the size of the lot, use of it by non-locals, displacement of buildings on whatever site was chosen, and especially over pedestrian and bicycle access to the proposed Station. The construction of I-5 had isolated neighborhoods on either side of it and had created circuitous patterns of movement so that children within a quarter-mile of school still had to be bused there. Traffic volumes and road-way widths made the Barbur/Capitol intersection "a hazard and barrier" for pedestrian and bicycle movement. These considerations led to the inclusion of a pedestrian/bicycle bridge over I-5 to the Huber Street

[1] Dotterrer memo.
[2] Munch.
[3] City Bureau of Planning press release, August 28, 1978.
[4] P. 43, EIS.

neighborhood, bicycle parking, and pedestrian/bicycle pathways to the Station. Neighborhood opinion also had much to do with limiting the size of the park-and-ride lot and its construction on a site where minimal displacement would occur. The site selected contained four businesses, three one-family homes, and 27 motel rental units.[1]

Planning focused on the Station and park-and-ride site. The Bus Lane itself was treated only as "the tail" to this complex. However, community concern over the safety of the Bus Lane led to the inclusion of sidewalks in some places along it. Concern was especially directed at the intersection of Barbur with Hamilton Street. This was the only signalized intersection on the Bus Lane and a major entry/exit point for the University of Oregon Medical School/U.S. Veterans Hospital. This medical complex had 5,700 staff, employees, and students in 1975. The Hamilton intersection was the major point on the 1.8 mile Bus Lane where left turns were to be permitted in off-peak periods. There was also concern that as Boulevard traffic grew, it would divert to scenic, residential Terwilliger Boulevard.[2]

The concern over the Barbur/Hamilton intersection was amply justified. A large share of the $608,000 spent on the Bus Lane went into widening this intersection to four through lanes, a left-turn pocket adjacent to the median bus lane, and a large rubber tire-padded block barrier in front of the left-turn pocket, protecting the pedestrian island (see Diagram I-1).

The greatest local objection to the Bus Lane was over the peak period ban on all left turns. This ban meant that the Bus Lane would act as a divide through this sector of the City. Those seeking to cross between 6:30-9:30 a.m. and 3:30-6:30 p.m. would have to drive to the Barbur/Hamilton intersection, turn right on Hamilton, turn around, and cross Barbur on Hamilton perpendicularly - a crude facsimile of a jughandle maneuver.

There was also skepticism about the benefits of the lane, especially in bus time savings to counterbalance the time lost by those detoured by the left turn restrictions. The Bus Lane's sponsors believed bus travel times on the 1.8 mile stretch would be reduced by three to five minutes. However, this projected time savings apparently referred to the Lane's

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[1]P. 69, EIS.

[2]Letters, Richard Chamberlin, Chairman, Planning Committee, Homestead Neighborhood Association, to Council on Environmental Quality, August 15, 1975, and October 3, 1975, Portland, OR; and Munch.

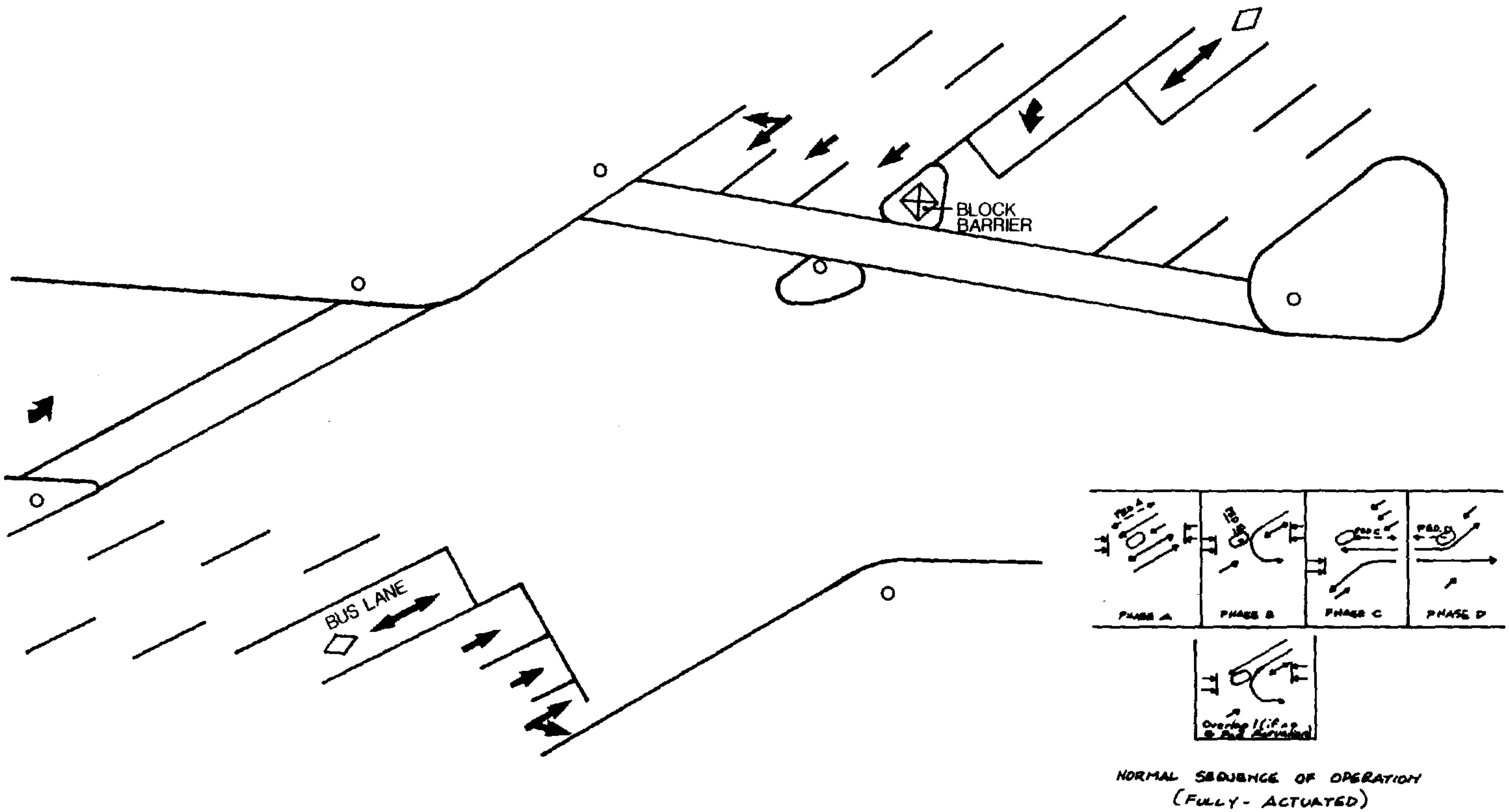

Diagram I-1
South-West Barbur Boulevard at Hamilton Street

performance under projected 1990 traffic volumes.[1]

6. Project Engineering

After the Bus Lane project received approval from the City Council in December, 1974, the ODOT set about the design, engineering, and later, construction work. The simplest traffic engineering changes involved were the removal of the lightly used curbside parking spaces along this section of Barbur, line and diamond striping, and the hanging of overhead and wayside regulatory signs.

The costly capital work involved construction necessary to maintain a uniform five-lane boulevard (or four lanes with two southbound entering ramp lanes at Front Avenue). This required widening of the Boulevard in places, especially at the Barbur/Hamilton intersection, where left-turn pockets were to be included. A new signal face, pedestrian island, and left-turn bay were installed at Barbur/Hamilton because of the critical importance of this intersection. A concrete block barrier with a decelerator cushion of rubber tires was placed between the end of the left-turn bay and the pedestrian island (Photographs I-2 and I-3). The Boulevard, constructed in the 1930's, was built on top of an old railway right-of-way; the solid sub-base and base were only under the median portion. Some of the concrete and asphalt pavement and base on the outer lanes had to be replaced, an expense which might eventually have been incurred, Bus Lane or not. Sidewalks had to be constructed in sections. Buttressing or construction of retaining walls were also necessary in one rock slide area.[2] These expenses were also not necessarily Bus Lane-related and were useful for general improvement of the Boulevard.

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[1] "Barbur Bus Lane News", undated press release of ODOT, Tri-Met, and City of Portland; Tri-Met News August 28, 1978, p.4; Dotterrer memo; and Chamberlin October 3, 1975 letter.
[2] Munch; and Max Klotz, ODOT to M. Cunneen, April 1981.

III. OPERATIONAL EXPERIENCE OF LANE

A. Barbur Boulevard Accident Problem

It was the intention of the sponsoring agencies that the median Bus Lane would function as an inbound morning express bus lane between 6:30 a.m. and 9:30 a.m. and an afternoon outbound bus lane between 3:30 p.m. and 6:30 p.m. (See Photograph I-3). No other vehicles were to be permitted on the median lane in peak periods even though express bus average headways would be four minutes. During off-peak hours, 9:30 a.m. to 3:30 p.m. and 6:30 p.m. to 6:30 a.m., the median lane "will be used as a continuous left-turn lane for both north and southbound motorists."[1]

From the first week of the project it became obvious that some motorists were using the Bus Lane as a left-turn lane during peak periods. This was partially due to confusion over the precise regulations governing the lane and partially due to the perception by automobile drivers that with bus frequencies so low, it was expedient to use the Lane. The Lane's markings were not visible at night. Also, between the Barbur/Hamilton intersection and the downtown terminus of the Lane, there was no way to cross the Boulevard. The same situation prevailed for a half-mile south of Hamilton. A few weeks after implementation, the Tri-Met project study team reported that: "Some bus drivers have refused to operate in the lane due to the perceived 'unsafe' conditions."[2]

Because of the newness and uniqueness of the Barbur Boulevard Bus Lane, there were conflicting interpretations of the regulations governing it. A police officer was enforcing a "no turn across double lines" interpretation, nullifying the intended off-peak left-turn use of the lane. While signs were up indicating "NO LEFT TURN - 6:30-9:30 a.m. 3:30-6:30 p.m. WEEKDAYS", the entire contents of this sign were difficult to read at 35 m.p.h. Motorists seeking to make left turns were in an awkward position. Should they violate the ban by pulling into what looked like a nearly empty lane and make an illegal left turn? Was it legal to make a left turn not from the median lane, but from the left through lane? Should crossing the Boulevard be made only by exiting to a side street on the right and turning around, crossing Barbur from the side street? Was there anything to prevent usage of the off-peak median lane as a through lane with the risk of a head-on collision? One

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[1] "Basic Facts About the Barbur Boulevard Bus Lane", Portland Bureau of Planning press release.

[2] Tri-Met intra-office memorandum; Clyde Earl, Ron Higbee, and Ken Stanley to Paul Bay and Jim Cowen, October 5, 1978. (hereafter: Tri-Met memo).

judge was quoted as saying that he felt a suit would eventually be brought as a result of a ticket or accident.[1]

Other potential safety problems were brought to the attention of the Oregon DOT by Portland Police and motorists: buses changing lanes in heavy traffic to pick up or discharge passengers at the curbside; left-lane traffic cutting into the bus lane; and conflict of buses and general traffic merging at both ends of the Bus Lane.

During the first year of Bus Lane operation (September 1978 to September 1979) Tri-Met buses suffered an average of one accident every thirteen days, or one for every 80 hours of operation. This compared to one accident every 1,400 hours for the rest of the Tri-Met system. Of the first year's accidents, seventeen out of twenty involved a private vehicle illegally in the Bus Lane (mostly making left turns into the path of a bus) and nine of the twenty accidents took place at one intersection, Barbur and Hamilton.[2]

With better signing, enforcement, and greater motorist awareness of the problem, the number of accidents was substantially reduced in the Bus Lane's second year of operation (September 1979 to September 1980). The number of accidents fell to seven, one for every 226 hours of operation. Five of the accidents occurred at the Barbur/Hamilton intersection.[3] The present problem occurs at a single intersection (see Photographs I-4 and I-5.) The private vehicles who struck or were struck by buses at Barbur and Hamilton were attempting an illegal 90 degree turn to either reach Hamilton across Barbur Boulevard or make a U-turn.

To remedy the situation at Barbur and Hamilton, it had been suggested as early as late 1978 to double the left turn capacity for Hamilton westbound to Barbur southbound traffic. It was also suggested that the Barbur/Hamilton traffic light sequence be changed to release median lane buses at the end of the southbound Barbur phase, thereby reducing the competitive merging between #54 and #56 buses and traffic as the buses seek the Slavin Road exit.[4] However, it is now generally acknowledged by all relevant agencies that as long as the median Bus

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[1]Letter, M.J. Martini, Senior Traffic Engineer, to L.E. George, State Traffic Engineer, December 28, 1979.

[2]Letter, Ron Higbee, Manager, Engineer Services, Tri-Met, to Portland Police Chief Bruce Baker, June 23, 1980.

[3]Inter-office memorandum, Tri-Met, Clyde Earl to Ron Higbee, September 23, 1980.

[4]Oregon DOT intra-office memorandum, Robert N. Bothman, Administrator, to E.L. Hardt, Metropolitan Region Engineer, December 1, 1978, Portland, OR; and Tri-Met memo.

Lane is in operation, nothing short of an expensive capital improvement will remedy the safety situation. The ODOT and TriMet are exploring possible designs. In the meantime, the hope is that the accident rate will decrease to a satisfactory level.

Reasons cited for the accident problem include: the unfamiliarity of non-local motorists with lane regulations, the tendency of downhill Hamilton Street traffic to roll quickly through the intersection and the high speed of buses on the Lane. A City traffic official who rode to work on Barbur Boulevard express buses said that the bus drivers tend to take the exclusive lane regulation too literally, operating at high speed regardless of the danger from flanking traffic and are reluctant to apply brakes which throw standing passengers. He recounted an experience illustrating the misunderstanding by drivers on how to deal with the Lane. A bus driver approached a car waiting to make an illegal left turn from the Bus Lane. The bus driver passed this car on the left against oncoming traffic, risking a left turn broadside from the car he was passing. The anticipation of similar or worse incidents among express passengers gives way to "a collective sigh of relief", as one Tri-Met official expressed it, when buses exit the median lane.

The safety problems of the reversible median bus lane on Barbur Boulevard are not unique. Other reversible lane projects elsewhere have experienced similar accident problems. A 1979 reversible median lane on Phoenix, Arizona's 7th Avenue, involving similar peak period bans on left turns and continuous off-peak two-way left turns, met with a 128 percent increase in evening peak accidents with sideswipes up 650 percent.[1] Accidents quadrupled on reversible lanes in Washington, D.C. There were problems of motorist uncertainty over the median lane regulations on the San Bernardino Freeway Express Busway, mentioned in the Los Angeles section of this report. The judge in Los Angeles dismissed violations on the Busway, agreeing with the motorists that the original regulations were unclear.[2]

B. Ridership and Bus Operations

Average daily ridership on the five express bus routes from Fall 1977 to Fall 1980 using the Barbur Boulevard Bus Lane is shown in Table I-1. Express ridership has generally fallen slightly since Fall 1977, when the Transit Station opened, and

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[1]Nazir Lalani and Avorald L. Baird, "Right Way of Wrong Way Driving", ITE Journal, April 1980, Vol. 51, No. 4.
[2]pp. 93-94, Crain & Associates, San Bernadino Freeway Express Busway, Evaluation of Mixed-Mode Operations, Final Report, for SCAG, July 1978, Menlo Park, CA.

since Fall 1978, when the median Bus Lane came into operation. Two of the routes made gains (#38 and #45), one has held even (#44), one has declined moderately (#54); and one has declined considerably (#56). Ridership had increased on these routes before 1977 as it had on the Tri-Met system in general from 1977 on. In the year following the June 1979 institution of timed transfer, West Side local routes grew 40 percent in ridership.[1]

It cannot be determined if buses' share of people movement in this corridor has changed between 1978 and 1981 because insufficient traffic and auto occupancy data exists.

Many factors effect ridership. Most cannot be accounted for as they relate to employment and residential shifts over time. Fares on the express buses have increased from a 40 cent flat fare in 1978 to 65 cents in Zone 2 and 90 cents in Zone 3 (suburban area beyond the Transit Station) in 1980. The slight decline in express bus ridership shown in Table I-1 is mirrored by the fact that Tri-Met is running almost the same number of peak period buses there in 1981 as it was in 1978, disappointing the project's planners who expected 4,500 express riders by 1990.[2] The capacity of the buses has not changed though articulated buses are planned for route #44, perhaps replacing two standard size peak period buses.

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[1] p. 14, West Side Corridor.
[2] Dotterrer memo; and "Barbur Bus Lane News"

TABLE I -1

Average Daily Ridership
Barbur Boulevard Express Buses
Fall 1977 to Fall 1980

Bus Route	Fall '77	Win 77-78	Sp '78	Sum '78	Fall '78	Win 78-79	Sp '79	Sum '79	Fall '79	Win 79-80	Sp '80	Sum '80	Fall '80	% Change F77-80/78-80
38	486	480	505	425	482	549	544	425	482	549	544	1352	674	+39/+25
44	1860	2000	2150	1800	2110	2130	1810	1800	2110	2130	1810	1860	2120	+12/+0
45	1559	1628	1426	1422	1345	1318	1698	1422	1345	1318	1698	13451	1584	+1/+15
54	2210	1987	2083	1652	2066	2008	2385	1844	2388	1895	2130	1606	1915	-15/-8
56	2469	2271	2469	2383	2477	2272	2417	2093	1885	2241	2135	1887	1922	-28/-29
TOTAL	8584	8366	8633	7682	8480	8277	8854	7583	8210	8133	8317	8050	8215	-5/-3

SOURCE: Tri-County Metropolitan Transit District
Portland, Oregon.

IV. PROJECT ANALYSIS

A. Bus Speed and Operations

The express buses operating on the Barbur Boulevard median Bus Lane move an average of a minute and a half faster than local buses operating on Barbur. However, this small time advantage is only partially due to the exclusive right-of-way. Most of the minute and a half delay experienced by local buses involves picking up or discharging passengers along the Boulevard - an activity with which the express buses do not have to contend. While the Tri-Met evaluation of the Bus Lane's performance noted the time differences between the express and local services, it did not measure how much time the locals were spending due to passenger collection/distribution service.[1] Tri-Met observers believe the reserved lane per se has saved express buses little or no time compared to running with mixed traffic on typical days. The projected three or five minute time advantage did not materialize because traffic congestion has not yet reached the projected 1990 levels.

For this reason the Lane is viewed by some as a good idea whose time has not yet come. An evaluation of the Lane's performance however, tends to have limited utility because the Lane was intended to be a response to 1990 conditions and to be in place before the problem arose.

The December 11, 1974 City Council ordinance authorizing the Lane and the use of Federal Interstate funds on its behalf indicates that: "...the Council requests the Highway Division and Planning Commission (ODOT) to give high priority to the construction of an exclusive transit lane on Barbur Boulevard between West Portland and Slavin Road when it is warranted either by sufficiently high bus volumes or significant traffic congestion on that segment of the route..." (author's italics). Since neither the congestion nor the increase in bus volumes has yet materialized, the implementation of the Lane is premature as defined by its legal mandate.

The reversible Bus Lane could never be a panacea for freeing buses from traffic congestion. For one thing, there remains the problem of getting from the end of the Lane to the CBD Transit Mall as "...according to Tri-Met staff, the greatest time delays for the entire corridor are in the section from Sheridan Street to the Transit Mall..."[2] where any bus priority system would be difficult to implement.

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[1] Ron Higbee, Tri-Met, Summary of Findings, Barbur Boulevard Bus Lane Evaluation, November 28, 1978, Portland, Oregon.
[2] Dotterrer memo.

An alternative to the present situation is to eliminate the median lane as a bus lane and use it instead as a continuous left-turn lane or a reversible peak flow lane. The express buses would then either travel with traffic or go on a right hand bus lane with local buses. This latter suggestion has the disadvantage of slowing buses down as they wait for buses in front of them to pick up or discharge passengers. Also, a right hand bus lane would deny a heavily used through lane to auto traffic and would encounter right-turn conflicts. There is every likelihood that an all-vehicle reversible through lane acting as an off-peak left-turn lane would suffer from a similar, if not worse, accident problem. Another possibility is to install a bus priority system on this arterial and allow buses to operate in mixed traffic with the median lane for left turns only.

B. The Accident Problem

The accident problem for buses on the Boulevard's median Bus Lane has been bad enough to cause Tri-Met to seriously consider abandoning it. Tri-Met reports it has had to sustain increased operating costs due to accidents which exceed the minor savings in fuel and reduction in mechanical attrition gained by use of the Lane.

However, it is too early to evaluate how serious this problem really is. Accidents declined considerably from the first year of operation to the second and no serious bus-related accidents are on ODOT's record for the first few months of the third year. Also, all the second year's accidents but one were confined to a single intersection, Barbur and Hamilton, so that the problem - and any solution - is concentrated at one location.

C. Ridership

Ridership has declined slightly on the express routes operating on the Barbur Boulevard Bus Lane in the first two years of operation while Tri-Met system ridership has increased.

D. Energy Consumption

It is premature to judge the energy impact of this project as it was intended to serve the operating characteristics of the late 1980's and 1990's. So far, it has clearly caused far more fuel consumption than it has saved. This is mostly related to the amount of fuel involved in the construction of the Station, park-and-ride lot, and the widening and partial repaving of Barbur Boulevard. This capital investment of energy was intended to save energy in the long run. However, that lessened consumption has not yet begun. So far, there is no evidence of a modal shift from automobiles to buses in this corridor. What is clear, besides the capital energy expenditure, is that the Lane system causes slightly more operating energy to be consumed. Automobiles crossing Barbur during peak periods must use more fuel to execute circuitous turning maneuvers as left turns are banned. Energy is used to light and maintain the Station and the park-and-ride lot. Lacking a survey of patrons, it is not clear whether the people using the park-and-ride lot would choose to drive downtown if the lot were not available, nor from how far out in suburbia they originate. If the travel energy consumed in this corridor has been reduced it is probably not because of the Bus Lane, but because of changes within the automobile mode (i.e. greater vehicle occupancy or more fuel-efficient cars.)

How would energy consumption compare if the median lane were available to <u>all</u> traffic, either as a continuous left-turn lane or as a reversible through lane? Presently the Lane is carrying only about 1,500 people in 32 buses in the p.m. peak period. The two traffic lanes carry about 750 local bus passengers on 23 buses plus about 5,600 people in 4,000 automobiles (1.4 per car) at the most critical point in the same period. This is about double the number of people carried per lane on the Bus Lane. A third lane for reversible dominant flow movement is likely to raise the Boulevard's level of service and the fuel efficiency of all vehicles using the roadway.

E. Neighborhood Impact

The Lane *per se* has had a minimal, though slightly unfavorable, neighborhood impact. With the peak period left-turn ban, local drivers are inconvenienced. This is a problem for access to the YMCA, the Veteran's Administration Hospital complex, and some schools. People who live along the Boulevard also lost most peak period bus service -- half the Barbur Boulevard routes don't stop there anymore, though headways are still quite short and off-peak service unchanged.

Related aspects of this project had positive neighborhood impact -- particularly the construction of a pedestrian/bicycle bridge over I-5 near the Transit Station. This provided safe access to the Station and a shortcut for local trips, obviating circuitous auto journeys.

The Transit Station is an excellent facility for local residents traveling without cars. Pedestrian and bicycle access to it is adequate and bicycles can be safely parked there. However, there are few local residents within walking distance of the Station; off-peak use of the Station is minimal.

The intention of the Station's planners was to create a satellite business and medium density residential district around the Station. It was hoped that the Station would be patronized throughout the day and be an integral part of a satellite community of the CBD. This has not happened to date. Part of the reason is that while a large area of Southwest Portland is zoned for multi-family housing--the kind of density appropriate for a transit facility--most of this development is not within walking distance of the Station. Much of the high density zoning is on Southwest Capitol Highway and between I-5 and Southwest 35th Avenue. Also, most of the apartment dwellers in this part of town are not CBD commuters. As the Environmental Impact Statement (EIS) for the West Portland project noted: "The school (Portland Community College) is probably the generator of most of the new multiple-family residential and commercial development now located along Southwest Capitol Highway between the interchange and campus."[1] A survey conducted by the ODOT and the Jackson Community Association in 1973 found that only 28 percent of the area's residents would use transit service regularly, "reflecting low employment in the CBD by residents of this neighborhood."[2]

While the Station neighborhood may be an ideal place for the CBD commuter, few live there now. Nor does it seem likely that a significant new walk-access commuter population will be locating there in the future. The Huber Street study was "...prompted by rapid growth of multiple-family units which alerted local residents for the need for alternative land use and zoning policies."[3] Such alternative policies limit high-density residential construction in the immediate vicinity.

F. Washington County Transportation Impact

A major reason for constructing the Barbur Boulevard Bus Lane was to facilitate transit trips between Portland and suburban Washington County, for which CRAG had projected substantial population growth. However, Washington County had little participation in the planning of the project. Washington County had grown two-and-a-half times the metropolitan area's population growth from 1950 to 1970.[4] Currently, the MSD (CRAG) estimates a 72 percent population increase for Washington County between 1977 and 2000. Portland CBD employment is projected to grow by 60 percent during the same period, from 66,000 jobs to 118,000.[5]

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[1]P. 45, EIS.
[2]P. 15, Ibid.
[3]P. 42, Ibid.
[4]Westside Corridor, p. 6.
[5]Metropolitan Service District, Technical Memorandum #34, Interim II Population and Employment Forecast for the Year 2000, November 1980, Portland, OR.

The Washington County increase is predicted to effect the service area of the Barbur Boulevard buses (see Figure I-6). The Southwest Sector in Washington County, an area roughly south of Scholls Ferry Road,[1] is projected to grow 85 percent from 48,650 (1977) to 90,000 (2000). The Beaverton-Raleigh Hills Sector[2] of Washington County, partially served by Barbur buses and centrally located between the Sunset Freeway and Southwest Corridors, is projected to grow 55 percent, from 49,300 (1977) to 76,500 (2000). The northern and western parts of Washington County, for which the Sunset Freeway and not Barbur is the only feasible express bus route, is projected to grow 74 percent from 94,150 to 163,000.[3]

Presently, seven of the fourteen Tri-Met buses which connect Washington County with the Portland CBD travel on Barbur Boulevard--five of them as expresses (#38, 44, 45, 54 and 56) and two as locals (#43 and 55). In the 4:00 to 6:00 p.m. period Barbur Boulevard carries 46 of the 98 buses which travel outbound from downtown Portland to Washington County. During the same period another four routes (#57, 59, 88 and 89) connect Washington County with Portland via Route 26 (Sunset Freeway) carrying 40 of the 98 outbound buses. Of the other three bus routes from Washington County, the #46 travels via Terwilliger Boulevard, the #77 via Barnes and Burnside Roads, and the #37 (which has only a small portion of its route in the County) via Macadam Highway.

Buses from the Northwestern sector--all those on Route 26 as well as the #54 and #56 on Barbur--reach the area of Washington County north of the Barbur Boulevard/I-5 Southwest Corridor. Southwest Sector buses--#43, 44, 45, 46 and 38-- reach this corridor which contains 27 percent of Washington County's population. It may seem that the southern part of Washington County receives more bus service than the northern part. Actually, many of the southern sector buses may originate in the County, but travel mostly through Multnomah County, where they pick up most of their passengers. The Route 26 (Sunset Freeway) buses on the other hand carry Washington County riders only.

While Barbur Boulevard is, and can continue to be, a major conduit for Washington County buses into Portland, Sunset Freeway (Route 26) is better suited as an express route because it is a more direct route from most of the County, especially the

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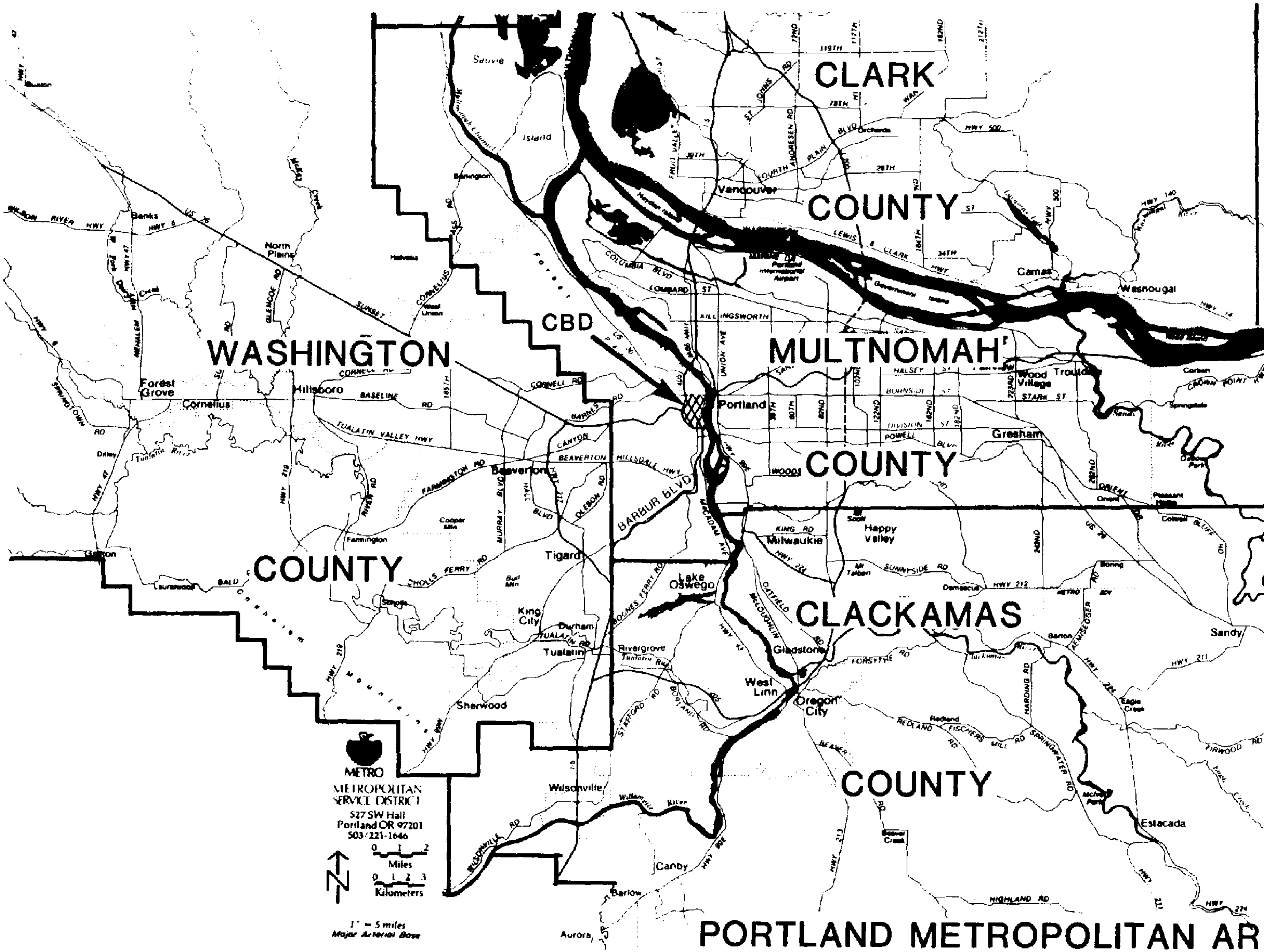
[1]Precisely, the MSD's Internal Districts 37, 47, 48, 49 and 50, including Tigard, Metzger, Garden Home, Durham, King City, Sherwood, Tualatin, Wilsonville, Mountain Home, Scholls, Midway, Laurel, and Farmington.

[2]Precisely, the MSD's Internal Districts 36, 38, 39 and 43.

[3]Ibid.



PORTLAND METROPOLITAN AREA

FIGURE I-6:

I-30

fastest growing portion. It is the County's main traffic link with Portland and is projected to be operating at level of service "E" or "F" by the year 2000.[1] Therefore some form of exclusive or priority bus treatment, as discussed in the West Side Corridor Study, would be necessary.

G. Transportation Utility of Project

The Barbur Boulevard Bus Lane and its related Transit Station were built to meet the year 1990 transportation needs. By this action the marginal benefits brought about by the Lane to date cannot be regarded as representative of target year conditions. The planners were concerned that when traffic congestion had increased on Barbur it might be politically difficult to establish a lane only for buses or interrupt traffic for roadwork. As one planner expressed it: "We got in while the getting was good."

For the next few years there are three additional factors which may tend to limit the utility of this under-utilized Lane. First, there is no indication that ridership on express buses will increase, since it has not increased in over two years while a general ridership increase was experienced in the Tri-Met System. Second, there is a possibility that some Beaverton area ridership will divert to the Sunset Freeway corridor if ramp metering, exclusive bus ramp access, an exclusive bus lane and other measures are introduced there (see Figure I-7).[2] Third, Tri-Met plans some changes in its system which would reduce the number of buses using the Lane. These changes are: substitution of articulated buses (at longer headways) for the present standard size buses on Route #44, and the possible termination of some suburban routes at the Transit Station, permitting transfers to the CBD and greater suburban feeder service to the Station. The latter change may effect only off-peak usage and not reduce the peak hour bus volume on the Lane.

The Transit Station is presently used sparingly for bus-to-bus transfers. Only three routes go there now and all three are CBD-oriented. The only transfers one can make are between points along the Southwest Corridor between these three routes, which parallel each other a short distance apart. Despite original plans, no new suburban or crosstown bus routes connect riders to the Transit Station.

The Lane and Transit Station represent a substantial transit infrastructure for the Southwest Corridor with the capacity for a great expansion of service. The Transit Station has four

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[1] Ibid.
[2] West Side Corridor

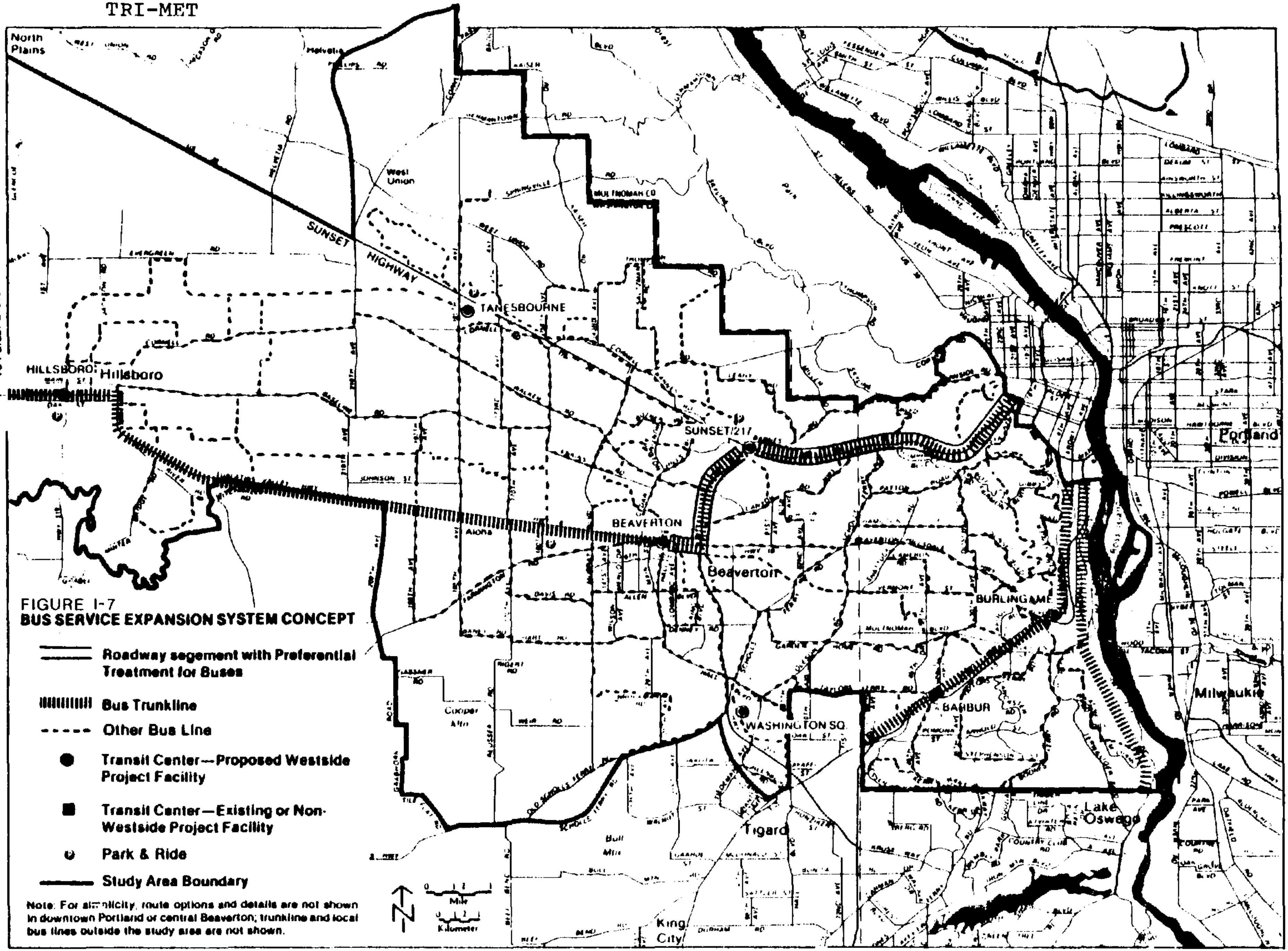

FIGURE I-7
BUS SERVICE EXPANSION SYSTEM CONCEPT

Note: For simplicity, route options and details are not shown in downtown Portland or central Beaverton; trunkline and local bus lines outside the study area are not shown.

bus bays capable of handling over one hundred buses an hour.[1] Presently, fifty buses use it in the a.m. peak hour. The Lane has only 19 buses on it in the a.m. peak hour--about one bus every three minutes. Buses during the peak hour are, on the average, over 1,600 feet apart; the Lane could operate at a much higher density. It is expected that within a decade or so, the Station and Lane will become more heavily used. In the meantime, Tri-Met would like to keep its foot in the door and retain the Lane despite its low usage.

H. Costs

The construction and engineering work related to the Bus Lane cost $608,000 (1978 dollars). However, much of this expense would have been necessary to upgrade Barbur Boulevard even if the Bus Lane was not implemented. Another $2,244,000 (1976 dollars) was spent on the Station, park-and-ride lot, and pedestrian/bicycle bridge. Other costs include: (1) Bus Lane maintenance at $1,100/mile annually; (2) Station maintenance costs at $25,000 the first year and $18,750 in subsequent years; and (3) park-and-ride maintenance at over $113,000 annually ($31.50 per month per space).[2] These figures represent 1974 dollars.

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[1]Dotterrer memo.
[2]P. G-6, EIS.

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In addition, other sources included: interviews with Michael Bauer, Portland City Traffic Engineer; Max Klotz, Oregon DOT; Ernest Munch, former Portland Senior Transportation Planner; Robert Shull, Washington County Transportation Department; Steve Dotterrer, Cynthia Kurtz, and Sarah Campbell, Portland Bureau of Planning; Michael Kyte, Stephen Smith, John Lackey, and Ron Higbee, Tri-Met; miscellaneous information provided by these and other individuals in ODOT, the City of Portland Bureaus of Traffic Engineering and Planning, and the Metropolitan Service District (formerly CRAG).

II. SECOND AVENUE BUS CONTRA-FLOW LANE, NEW YORK, NEW YORK

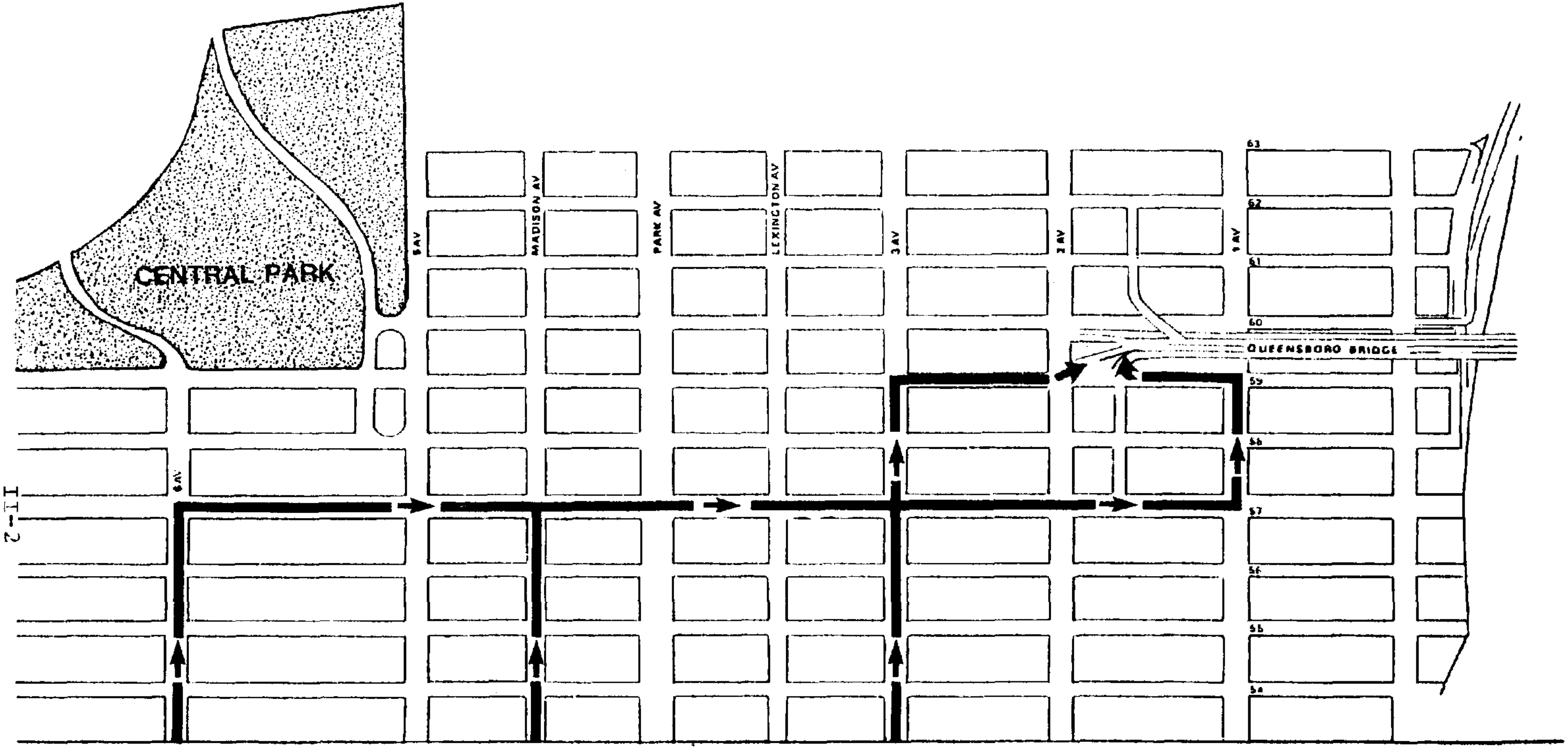
I. BACKGROUND

A. Brief Description

The Second Avenue Contra-Flow Bus Lane in New York City extends 450 feet (two blocks), occupying 18 feet of a 70-feet wide urban arterial. About 200-250 buses have typically used the lane in the 4:00-6:00 p.m. period when it is open out of about 4,000 vehicles with-flow on Second Avenue during the same time period. The lane was instituted on October 30, 1978 by the New York City Department of Transportation.

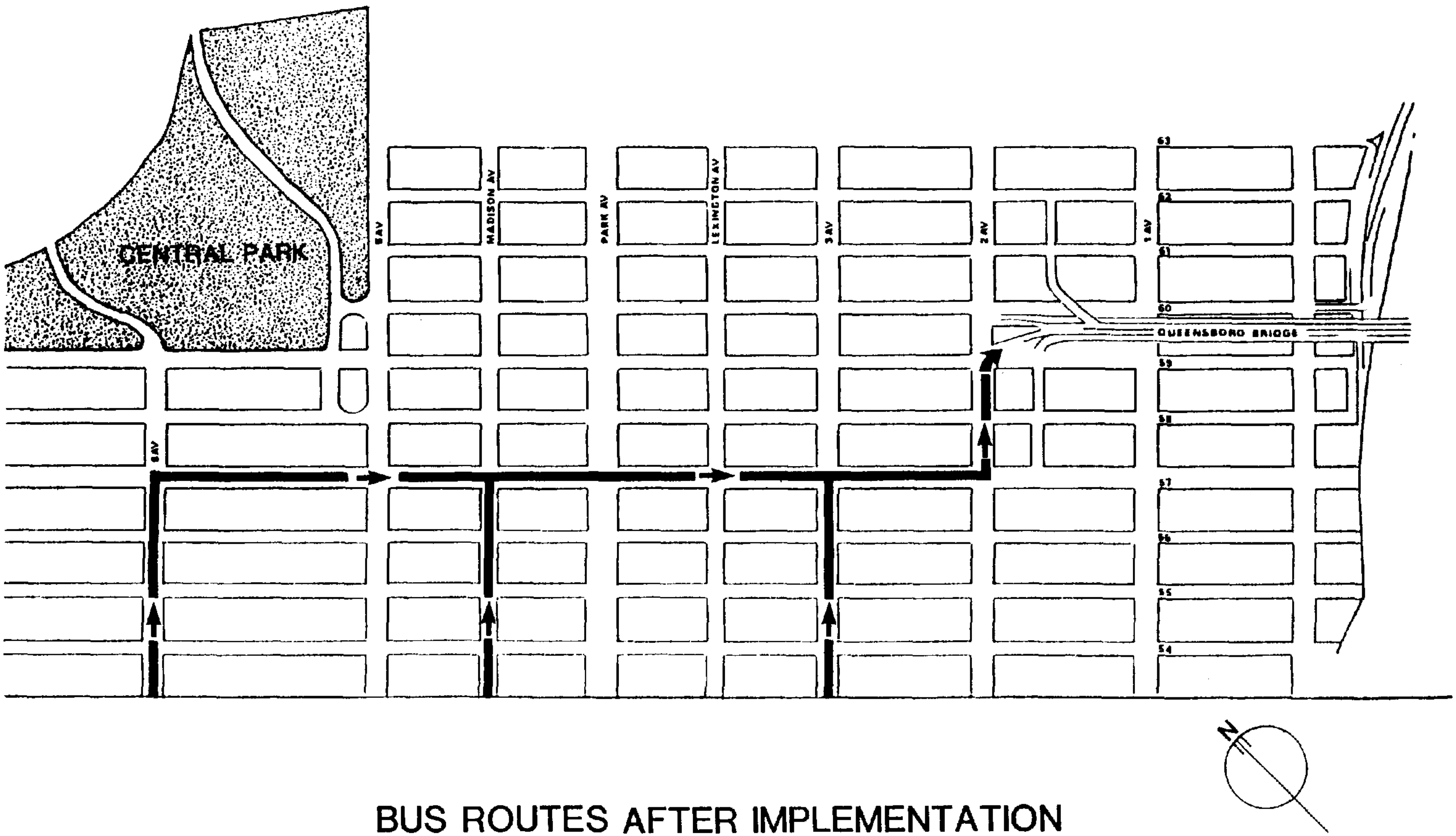
The purpose of New York City's Second Avenue Contra-Flow Bus Lane between 57th and 59th Streets is to expedite express buses using the 59th Street-Queensboro Bridge during the evening rush hours. These buses travel from the midtown Manhattan CBD to inner suburbs in Queens, a distance of twelve miles. All express buses to Queens must cross the East River using the 59th Street-Queensboro Bridge in order to reach Queens. To reach the bridge entrance in Manhattan, these buses must traverse a one-way street grid and board ramps off 59th Street between Second and First Avenues. Figure II-1 shows how conformance to the one-way network forced buses to take circuitous paths and make several turns to reach the bridge ramps. Figure II-2 indicates how bus movements were simplified by establishing a contra-flow lane on the east side of Second Avenue. Figure II-3 shows the present lane configuration of this segment of Second Avenue. The benefits of the contra-flow lane have been:

- faster bus trips.
- more consistent trip times (schedule adherence).
- fewer bus/pedestrian conflicts at intersections.
- lower bus vehicle miles traveled (VMT).
- less mechanical attrition on the buses and lower fuel consumption.
- a visible express transit improvement at a key traffic node.
- low capital and operational costs and short lead time.



BUS ROUTES PRIOR TO IMPLEMENTATION

FIGURE II-1



BUS ROUTES AFTER IMPLEMENTATION

FIGURE II-2

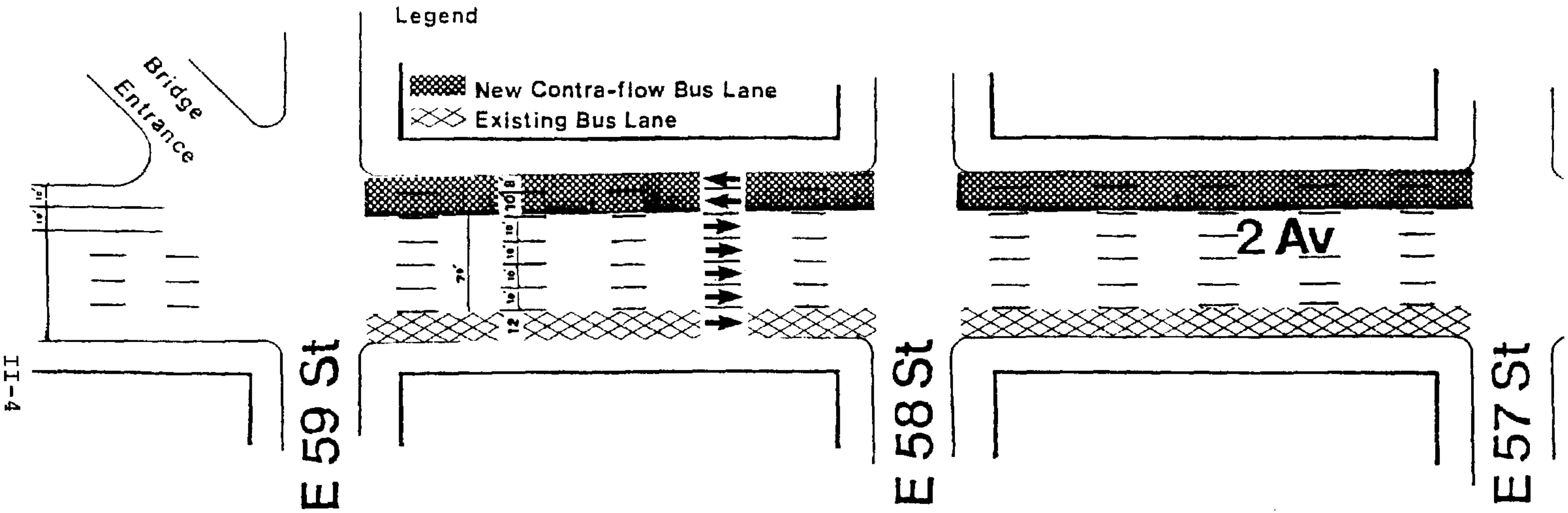


DIAGRAM OF CONTRA-FLOW OPERATION

FIGURE II-3

B. Prior Situation

1. Growth of Queens Express Bus Service

Express bus service between midtown Manhattan and the densely populated suburbs of Queens has grown substantially in the decade of the 1970's. The first Queens-Manhattan express service was begun in February 1968 by Steinway Transit, a private bus company which operates local transit service in Queens. In the subsequent seven years, fourteen additional routes were opened by private bus companies as were three by the New York City Transit Authority.

Queens has experienced enormous post-war population growth with much of the new development occurring beyond the termini of the City's subway lines. Much of the eastern Queens commuting population must use a local bus to get to the subway, hence paying a double fare. Bus and subway fares increased from 15 cents in 1960 to 75 cents in 1980 while subway problems of rush hour crowding and low speed have reduced the attractiveness of this dominant New York City travel mode. Fares and service on the Long Island Railroad (LIRR) which makes several stops in Queens, are not competitive; the LIRR stations are not located closely enough, and the LIRR trains deliver passengers to only one Manhattan destination (Pennsylvania Station). While New York City has had plans to extend subway service further into Queens and provide another LIRR terminal on the East Side of Manhattan, these plans have been postponed indefinitely due to a lack of financial resources.

These were the market conditions preceding the growth of express buses. While express bus fares are about thrice the standard transit fare, they provide a direct, one-fare, transfer-free service for many Queens commuters who would otherwise pay two fares. About 90 percent of Queens express bus riders are able to walk to the bus, and from the bus to their work places in Manhattan. More importantly, Queens express bus commuters experience a more comfortable journey with air conditioning and the availability of a seat, as compared to the crush load conditions of subway travel and the high rate of crime within the subway system. Eighty-three percent of Queens express bus riders surveyed cited "comfort and convenience" as their principal reason for choosing that mode. Over 90 percent of these express bus patrons have shifted from other transit modes (even though travel time and cost savings were minimal or even negative.[1]). Citywide express bus ridership grew from

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[1] Survey of Ridership of Express Buses in the City of New York, Summary Report, prepared by the Department of Transportation Planning and Engineering, Polytechnic Institute of New York, for the New York City Transportation Administration, May 1974.

4,000 to 350,000 rides per week, from 1968 to 1978.[1] Prior to the bus contra-flow project's implementation, there were over 7,000 Queens express bus riders.

2. Bus Operational Problems Reaching the Queensboro Bridge

While Queens express buses make different collection and distribution runs, they all share a common route in traversing the East River - inbound in the morning via the Queens Midtown Tunnel and outbound in the evening via the 59th Street Queensboro Bridge. Buses go inbound in the morning via the Queens Midtown Tunnel because they can take advantage of an exclusive bus lane approaching the Tunnel. However, such an outbound lane to the Tunnel on the Manhattan side cannot be instituted and evening Tunnel congestion and a bad approach preclude outbound use of the Tunnel.

Inbound ridership by express bus exceeded outbound ridership by as much as 20 percent in the late 1970's. The principal reason for this difference was the longer travel time for the outbound trip over the Queensboro Bridge. Inbound bus travel times have been reduced since 1971 by a two-mile contra-flow bus lane on the Long Island Expressway approaching the Queens Midtown Tunnel. Use of this lane has cut bus travel time by 33 percent along the two-mile stretch.[2] The inbound bus travel time has also been reduced due to a decrease in overall vehicular traffic (7.8 percent between 1970 and 1977) using the Tunnel, as tolls for this facility have increased from 25 cents in 1972 to $1.00 in 1981. Outbound buses using the Queensboro Bridge, on the other hand, had not been given any preferential treatment on their outbound trip. Outbound buses were further hampered by two factors:

1. Traffic increased 26 percent on the untolled Queensboro Bridge between 1970 and 1977 (see Figure II-4). This increase was the result of traffic diverted from the toll facilities[3] operated by the Triboro Bridge and Tunnel Authority (TBTA), as tolls were increased to $1.00 during this period.

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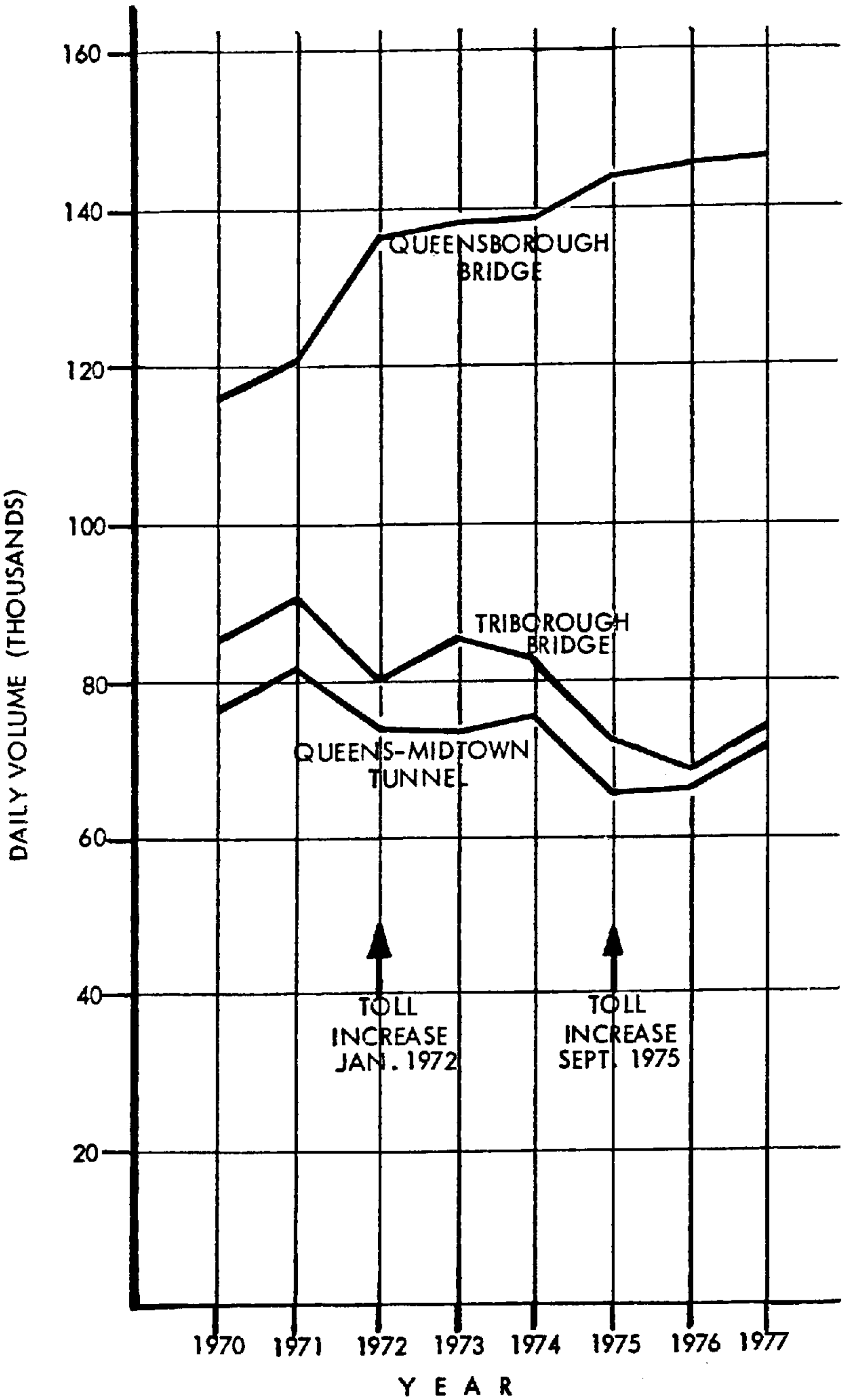
[1]New York City Department of Transportation Technical Report, Economic and Environmental Impacts of Express Buses, September 1978.

[2]Page 55, William Crowell, Preferential Bus Lanes on Urban Arterials: Selected Studies on Their Feasibility and Performance, UMTA-78-D-1, Washington, D.C., December 1978.

[3]Draft Technical Memo No. 9, Access To the Queensboro Bridge prepared for the New York City Department of Transportation and the New York City Department of Planning by Midtown Circulation project staff and Edwards and Kelcey, September 20, 1978 (hereafter: Memo 9).



EAST RIVER CROSSINGS:
1970-1977 DAILY VEHICULAR VOLUMES

FIGURE II-4

2. The bridge's upper roadway was closed to buses in 1972 because it was deemed structurally too weak to accommodate them after a four-month experiment of buses using the upper roadway.

Prior to closure of the upper roadway, the express buses could all travel east on 57th Street from Third Avenue and left onto a ramp to the bridge from 57th Street between Second and First Avenues (see Figure II-5). Use of the upper roadway worked out well in bus time savings (see Table II-1) and was the City's first TSM measure to cure this problem. With this ramp to the upper roadway no longer available, buses diverted one of two ways (see Figure II-1):

1. north on Third Avenue from 57th to 59th Streets and then east on 59th Street to the bridge; or

2. east on 57th Street to First Avenue and north on First Avenue to 59th Street, then west on 59th Street to a ramp entering the lower bridge roadway.

Both approach routes had problems. While the first was short, it involved traversing a badly congested area and making two turns; the second route involved much less friction with traffic and pedestrians but was longer and involved three turns, the last of which was virtually a U-turn within a narrow turning radius. This last turn is now prohibited to all traffic and that ramp entrance is blocked as its utility has been obviated by the contra-flow lane. A large volume of Queens-Manhattan local buses stop at the south side of 59th Street just east of Second Avenue to pick up passengers, then enter the bridge ramp on the north side of the street.

An analysis of these problem led to the eventual proposal for a bus contra-flow lane. The purpose of this lane was to speed up the evening outbound express buses reaching the Queensboro Bridge. The need became increasingly more pronounced as it became clear that the lead time, high capital costs, and administrative complexity of new subway construction to serve the burgeoning east midtown area of Manhattan made these projects impossible to implement in the foreseeable future. The City was particularly interested in fostering express bus ridership in order to draw as many Manhattan-bound commuters as possible from using automobiles. A 1970 survey found that 18.6 percent of all automobile commuters to Manhattan came from Queens.

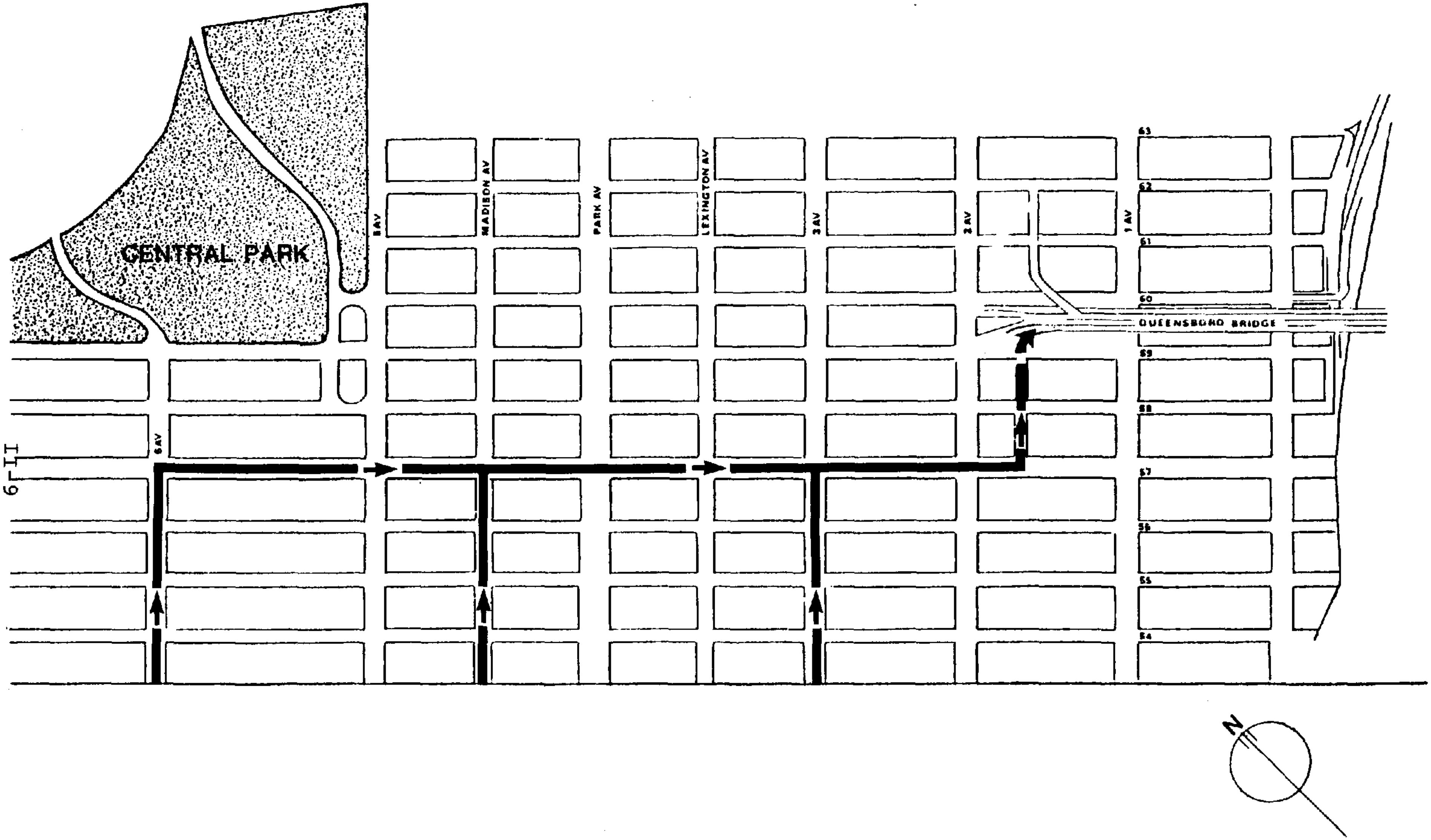


Figure II-5: BUS ROUTES USING UPPER BRIDGE ROADWAY IN 1972

TABLE II-1

QUEENSBORO BRIDGE EXPRESS BUS USE OF UPPER LEVEL 4PM - 7PM
FACT SHEET

I Results of Traffic Studies 1972

Route	No. of Buses	Before (Min)	After (Min)	Difference (Min)	%
6th Ave to Queens Blvd.	60	26	20	- 6	- 23%
6th Ave to Northern Blvd.	30	29	28	- 1	- 3%
3rd Ave to Queens Blvd.	30	14	8	- 6	- 43%
Madison Ave to Queens Blvd.	30	22	13	- 9	- 40%
TOTAL	150				

Average Time Savings/Trip (Queens Blvd.) - 7 minutes.

II Existing Conditions*

Number of Buses to Queens Boulevard	120
Number of Buses to Northern Boulevard	40
Time Savings to Queens Boulevard	7 Minutes/Trip
Time Savings to Northern Boulevard	1 Minute/Trip
Total No. of Passengers 4PM-7PM	6,500
Annual Benefit	$540,000

Note: Use of upper level by buses instituted on December 20, 1971; discontinued April 11, 1972.

*Tri-State Survey October 1975.

SOURCE: NYC Department of Transportation

II. PROJECT PLANNING

A. Perceived Advantages

New York City had already established inbound contra-flow lanes approaching the Queens Midtown Tunnel and the Brooklyn Battery Tunnel and had taken measures to improve the flow of buses on 59th Street and had instituted exclusive curb bus lanes elsewhere. Local buses on Second Avenue were already using an exclusive bus lane. The idea of a two-block contra-flow lane on Second Avenue was, therefore, a logical extension of prior measures to improve bus speed.

The major advantages foreseen under such a contra-flow operation were:

1. Bus travel time reduction by two minutes in the peak evening period, perhaps up to seven minutes in the peak quarter hour;

2. Less bus vehicle-miles of travel (estimated at 4,600 per year),[1] and

3. A reduction of pedestrian/bus conflict from a route with 4,900 peak-hour crossing pedestrians to a route along which only 2,700 pedestrians typically crossed during the peak hour.

Banning of left turns from Second Avenue onto 59th, 58th, and 57th Streets was deemed necessary for the success of the operation. As these turning volumes were low - 70, 200, and 40 vehicles per hour, respectively, no difficulty was foreseen as a result of the ban.[2] Subsequently left turns were allowed onto 58th Street.

It was also estimated that the southbound traffic of 2,000 - 2,500 per hour on Second Avenue south of 59th Street could be accommodated with one less lane due to the existing excess capacity within that segment of Second Avenue.

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[1]Michael Primeggia, New York City Department of Transportation intra-departmental memo to William D. Smith, October 11, 1978.

[2]Memo 9.

III. PROJECT IMPLEMENTATION

The contra-flow was instituted on October 30, 1978 and has been in continuous operation since then. In order to undertake this project, the New York City Department of Transportation had to take a number of steps:

1. The two-block stretch of Second Avenue had to be re-striped with double yellow thermo-plastic lines, and diamonds painted to indicate the 18' contra-flow along the eastern curb lane of Second Avenue.

2. Additional intersection control officers were required to direct traffic and set up and remove dividing cones and chains.

3. New signal faces at 58th and 59th Streets had to be retro-fitted onto the one-way traffic signals.

4. Curbside parking regulation signs had to be changed from "NO STANDING" to "NO STOPPING 7-10AM, 3-7PM."

5. Eight (8) overhead and twelve (12) curbside signs informing southbound traffic of the change had to be prepared and installed ("LEFT LANE CLOSED AT 59TH STREET - ONCOMING BUSES 4-7PM").

6. Forty (40) traffic cones and two chains for pedestrian traffic had to be set up.

7. Signing for the left-turn prohibitions ("NO LEFT TURN EXCEPT BUSES, 4-7 PM") had to be installed.

8. "LOOK BOTH WAYS" had to be painted on the crosswalks to inform pedestrians of the new two-way traffic, and six (6) "LOOK BOTH WAYS" signs had to be installed.

9. Additional police enforcement and tow trucks had to be provided to ensure enforcement.

10. A "NO RIGHT TURN" sign had to be installed facing the parking garage on the east side of Second Avenue, between 57th and 58th Streets (this garage was the only facility adversely impacted by the contra-flow operation).

11. A command post vehicle, walkie-talkies, and monitoring personnel with vehicles had to be ready for the initial days of the project.

12. Presentations and briefings had to be given to police, traffic control agents, bus operators, the Borough President's Office and affected community groups.

11. A command post vehicle, walkie-talkies, and monitoring personnel with vehicles had to be ready for the initial days of the project.

12. Presentations and briefings had to be given to police, traffic control agents, bus operators, the Borough President's Office and affected community groups.

13. A ban on street work permits to utilities had to be instituted for the week of the contra-flow lane inaugural.

14. Flyers were devised for bus users explaining the change and other flyers were distributed in major pedestrian generator in the area.

Figure II-3 shows the striping and lane configuration of Second Avenue with the contra-flow lane. A yellow double-striped line separates the contra-flow lane from southbound lanes. Thirty (30) of the seventy (70) available feet of Second Avenue at this stretch are reserved for buses. The New York City Department of Transportation had re-striped this section of Second Avenue earlier in 1978. To allow for an additional traffic lane, the previous 13'-11'-11'-11'-11'-13' lane width configuration was changed to 12'-10'-10'-10'-10'-18' (see Figure II-3). The contra-flow lane could have been implemented with the earlier striping but would not have incorporated the wider margin now in use. Southbound local buses frequently avoid the narrower southbound bus lane on the western side of the Avenue because the stopping and bunching of buses there coupled with the taxi use of this lane precluded its use as a through lane. The 18' contra-flow lane (1.3 buses per minute average) is used as a de facto bicycle lane as bicycle movement on the southbound lanes competes with taxi and bus pullover maneuvers.

An important ancillary operation was simultaneously instituted three months later. Fifty-ninth Street was made one-way between Second Avenue and the Bridge ramp; westbound 59th Street traffic could also get onto this Bridge ramp. If problems developed on Second Avenue, buses would use First Avenue and 59th Street westbound to reach the Bridge.

IV. PROJECT CHARACTERISTICS AND IMPACT

A. Safety

In its sixteen months of operation, no pedestrian or traffic accidents could be directly attributed to the bus contra-flow lane. It should be noted that midtown Manhattan pedestrians are not accustomed to two-way avenues nor contra-flow operations.

B. Traffic

As southbound Second Avenue traffic lost one lane, travel speed dropped from 11.2 to 8.2 m.p.h.; some of this speed reduction may be attributed to an increase in southbound traffic after the project's implementation as noted by the New York City Department of Transportation. With some buses removed from First and Third Avenues, traffic speeds on these thoroughfares increased from 8.6 to 9.7 and 5.7 to 5.8 m.p.h. respectively.[1]

C. Bus Operations

Buses save an average of one to two minutes per trip and up to seven minutes during most congested periods, with the contra-flow lane. Bus speeds from Third Avenue and 57th Street to the Bridge increased from six to eight m.p.h. Because of the increased number of bus runs from the time of the original estimate, the annual bus miles saved were re-estimated to be 5,200. The total passenger time savings amounted to 43,000 passenger hours per year.[2] The 5,200 bus miles saved annually, are equivalent to roughly 1,730 gallons of diesel fuel saved annually (assuming 3 m.p.g., New York City peak period estimate). The actual advantages to buses are slightly understated as some charter buses are also using the lane.

Ridership on these express bus routes has also grown. Annual ridership on all Queens express buses went from 5,355,000 (1977) to 5,538,000 (1978) to 6,772,000 (1979)[3] despite a long 1979 strike against Green Bus Lines, which operates three of the sixteen routes and held 5 percent of the 1978 ridership. Daily passengers grew from 8,176 (October, 1977) on 194 buses

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[1] Michael Primeggia, New York City Department of Transportation, intra-departmental memo to William D. Smith, February 14, 1979.

[2] Ibid., p. 13.

[3] Andrew Hollander, NYCDOT to Michael Cunneen, phone conversation, February 1981.

to 8,373 (October, 1978) on 233 buses to 10,780 (October, 1979) on 210 buses (decrease due to Green Lines strike).[1]

D. Air Quality

Six months after the lane's opening, estimates were made of the pollutant emissions reduced because of the reduced bus VMT. These were estimated to be 32 percent less hydrocarbons, 33 percent less carbon monoxide and 32 percent less nitrous oxide.[2] However, as southbound traffic increased and became more congested, it correspondingly gave off more pollutants. No air quality monitoring was undertaken by the City to measure this. However, using the U.S.E.P.A.'s MOBILE 1: MOBILE Source Emissions Model (EPA-400/9-78-005-007) the changes in emission levels of the traffic (southbound and contra-flow northbound) can be estimated for both before the implementation of the contra-flow lane and afterwards. Those estimates for the 600' two-block area with 2,050 vehicles are shown below.

	BEFORE		AFTER	
	Daily Grams/Mile	Tons/Year	Daily Grams/Mile	Tons/Year
Hydrocarbons (HC)	8.84	0.131	11.33	0.176
Carbon Monoxide (CO)	96.81	1.435	126.95	1.972
Nitrous Oxides (NOX)	3.36	0.050	4.67	0.073

The reason for the increase in emission levels is that the southbound speed has been reduced as southbound vehicles are squeezed into less width. The higher emissions levels from southbound traffic on these two blocks do not represent the entire air quality impact. The removal of buses from First and Third Avenues tends to raise speed and hence lower emission levels there slightly. However, pollution levels are more critical on Second Avenue because of the high pedestrian traffic there going to Queens local buses and the Roosevelt Island Tramway.

E. Project Costs

The New York City Department of Transportation has made no dollar estimate of the costs involved. Capital costs included only expenses for signs, re-striping, chains and new northbound signal faces. Operational costs are the labor costs for the five to six traffic control agents assigned to the project between the hours of 3:00 and 7:00 p.m., Monday through Friday, except holidays.

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[1] Ron Reed, Tri-State Regional Planning Commission (TSRPC) to Michael Cunneen, phone conversation, February 1981.
[2] New York City Department of Transportation.

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F. Extension of Project

It has been proposed by the New York City Department of Transportation that the two-block contra-flow bus lane be extended to ten blocks, going south to 49th Street to connect with the Crosstown Public Transportation Corridor at 49th/50th Streets from which through automobile traffic is currently prohibited midday between the hours of 11 a.m. and 4 p.m. This Crosstown Corridor is under study by the City with a mind to expand both its extent and hours of operation.

V. CONCLUSIONS

The Second Avenue contra-flow lane has been a useful, if small scale, aid to express bus service. A clearer picture of how well it is working will emerge when bus passenger and traffic counts are conducted in the future. However, given the growth in express bus ridership and the protection from peak hour congestion given these express riders, the lane can be judged as successful.

III. SECOND AND MARQUETTE AVENUES, CONTRA-FLOW BUS LANES, MINNEAPOLIS, MINNESOTA

I. CAPSULE PROJECT DESCRIPTION

The Second & Marquette Avenues Contra-Flow Bus Lanes, Minneapolis, Minnesota were instituted in September 1974 to speed up movement of express buses in and out of downtown Minneapolis by freeing them from general traffic congestion. The lanes are operative 24 hours daily and open all times to buses and taxis; open to trucks for loading and unloading operations only at all times other than 7:00-9:00 a.m. and 4:00-6:00 p.m. The lanes extend for 5,000 feet on Marquette and 4,500 feet on Second and are 18-20 feet wide on a 60-70 feet downtown urban arterial.

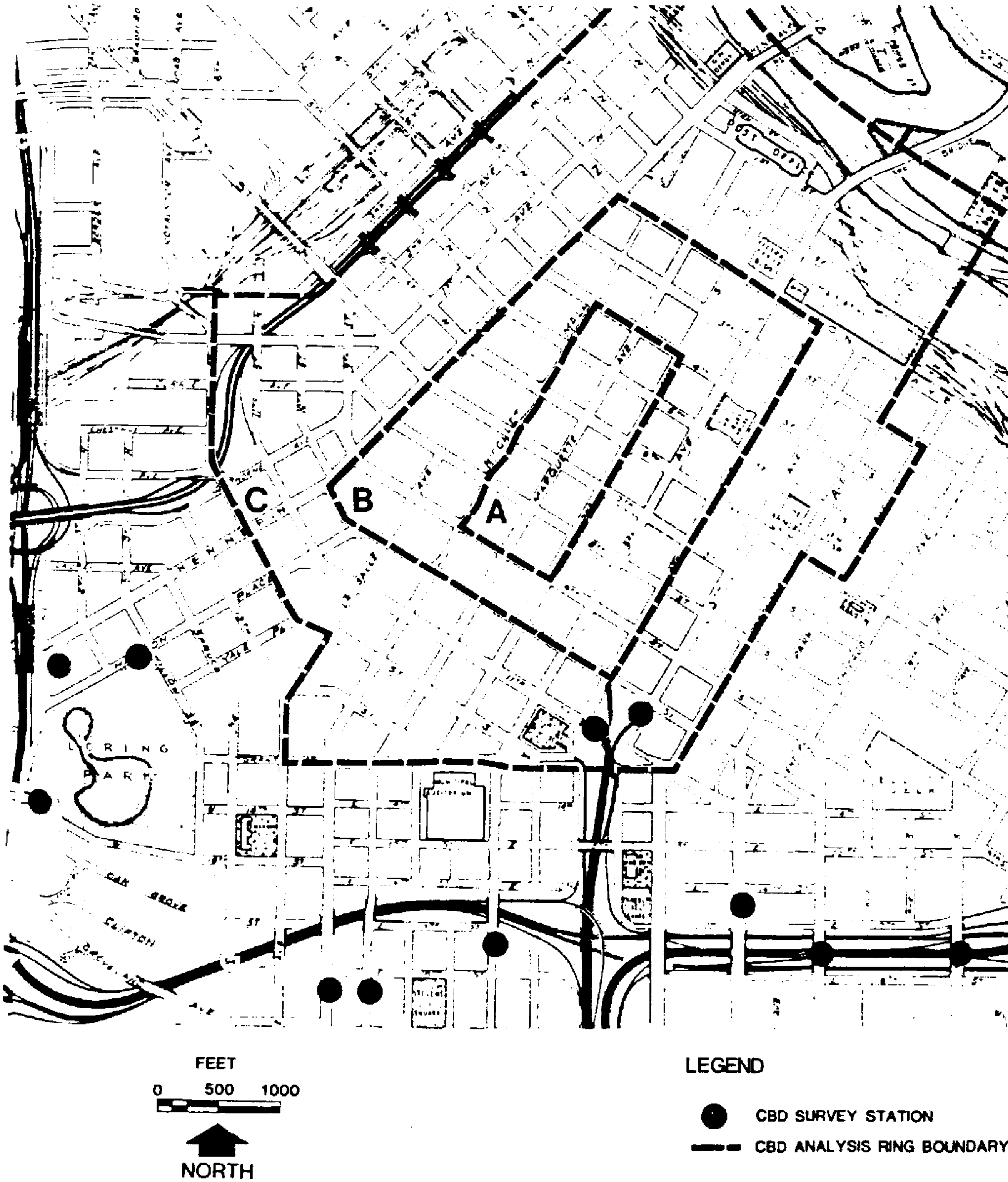
The impact of this contra-flow treatment was a 20 percent decrease in delay to buses - more than one minute per bus trip saved, seven percent growth in bus ridership in first 90 days of contra-flow operations, and improvement in truck operations. Problems encountered included slightly higher traffic congestion on balance of roadway and auto access problems to building along contra-flow lanes. $805,000 (1976) capital costs of permanent installation; $25,000 (1974) to initiate on experimental basis

The City of Minneapolis, Minnesota instituted reverse flow bus and taxi lanes in September 1974 on the downtown portion of Marquette and Second Avenues, respectively one and two blocks east of the Nicollet Mall Transitway. The effected portions of Marquette and Second Avenues plus the Nicollet Mall constitute the CBD Core Avenues of Minneapolis (see Figure III-1). The Nicollet Mall is a twelve-block pedestrian mall on the downtown portion of Nicollet Avenue. Within the mall is a serpentine, two-lane transitway for buses and taxis. The Mall was begun in 1967 and its acceptance led to local interest in more bus preferential lanes. Lane diagrams are shown on Figures III-2 and III-3.

The Marquette and Second Avenue contra-flow lanes have been in operation since 1974 with minor modification. For both avenues, the lanes are 18'-20' wide, allowing buses and taxis to pass one another. The reverse flow lanes are separated from the three oncoming traffic lanes by a one foot high mountable curb with three feet high orange highway cones on top.

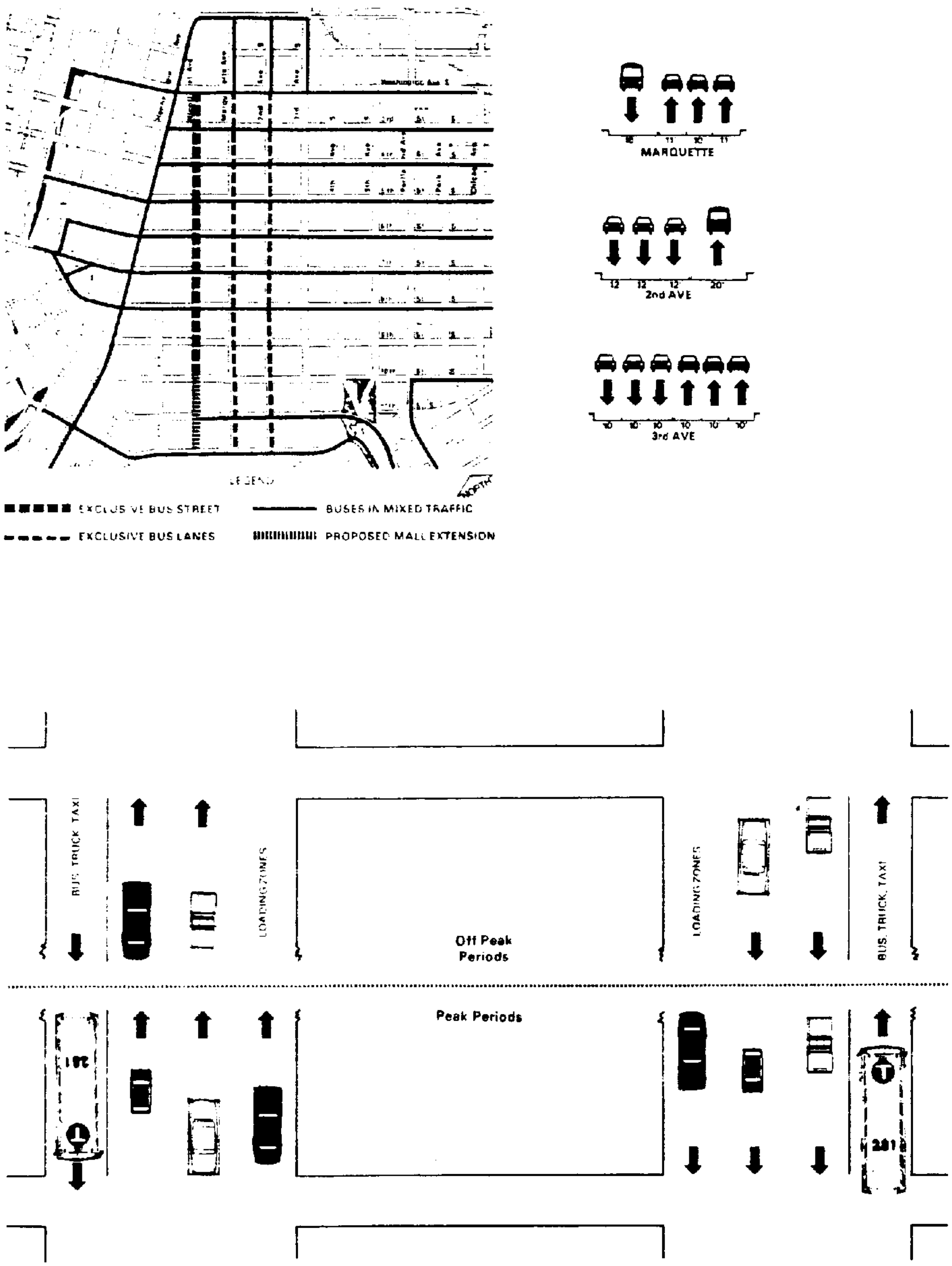
It is generally acknowledged that the reverse flow lanes have facilitated bus and taxi movement, saving buses one to two minutes of travel time. The lanes have also enhanced truck and van pickup and delivery on the reverse flow side of these avenues, the lanes are 18'-20' wide, allowing buses and taxis to pass one another. The reverse flow lanes are separated from

Figure III-1 : DOWNTOWN MINNEAPOLIS (ZONE A)



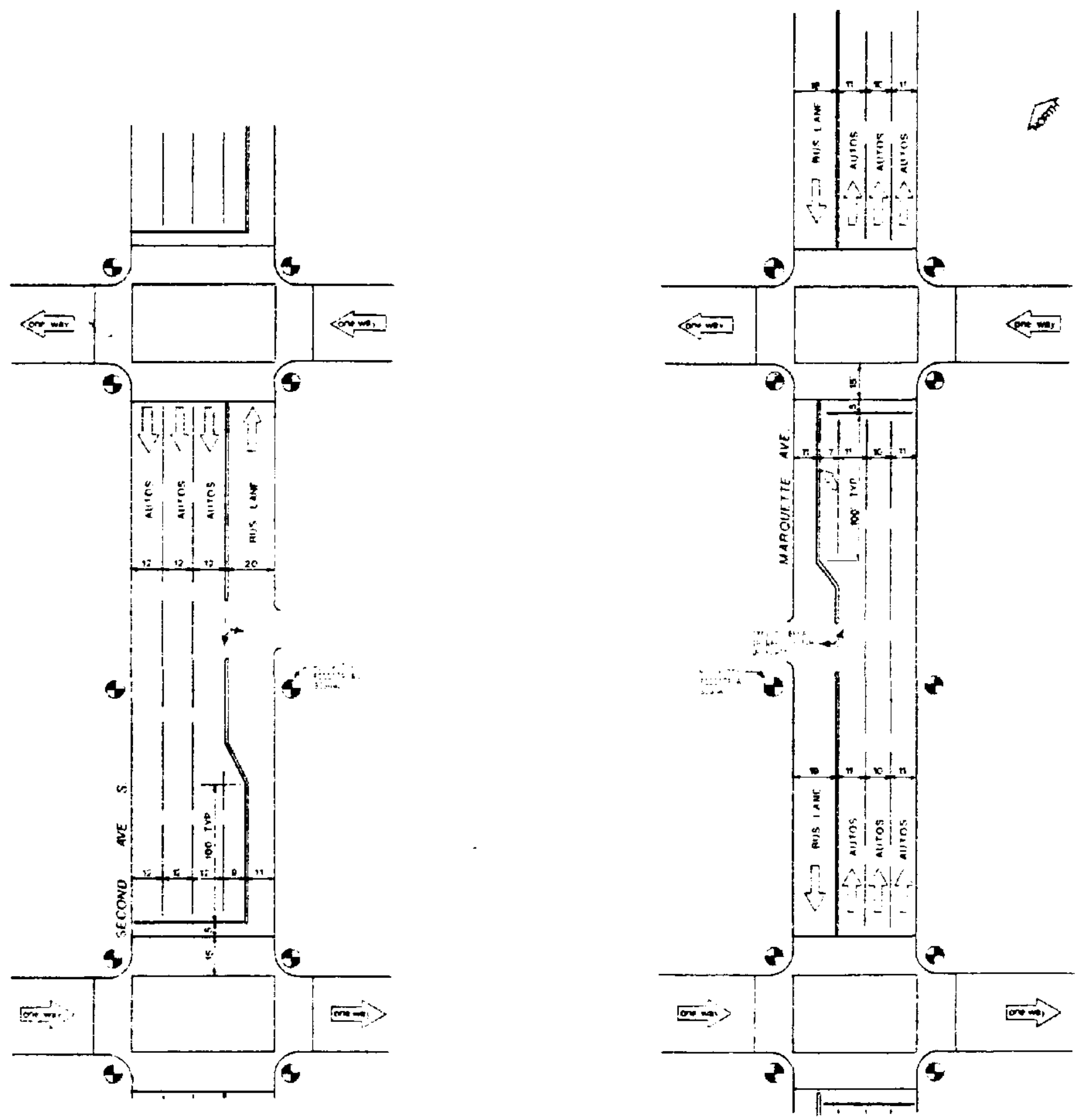
CBD Survey Station and Analysis Rings Map from : Bather-Ringrose-Wolsfield, Inc., Final Report for the I-35W Urban Corridor Demonstration Project, 1975.

Figure III-2 : CONTRA FLOW LANE ARRANGEMENT, MARQUETTE AND SECOND AVENUES, MINNEAPOLIS



From : <u>Downtown Minneapolis Bus Lanes Alternatives Study</u>, Barton-Aschman, Associates, 1976.

Figure III-3 : DIAGRAM OF CONTRA FLOW LANES



Barton-Aschman Associates

the three oncoming traffic lanes by a one foot high mountable curb with three feet high orange highway cones on top.

It is generally acknowledged that the reverse flow lanes have facilitated bus and taxi movement, saving buses one to two minutes of travel time. The lanes have also enhanced truck and van pickup and delivery on the reverse flow side of these avenues; freight vehicles are allowed in the lane at all hours except 7:00-9:00 a.m. and 4:00-6:00 p.m. However, traffic congestion is somewhat worse on these avenues and there are lingering problems with automobile access to buildings, especially parking garages and hotels.

II. PROJECT BACKGROUND

The conditions which led to the institution of the Marquette and Second Avenue contra-flow lanes were:

1. increased bus volume, especially suburban express bus movement into and within the Minneapolis CBD;

2. a governmental consensus in the Twin Cities area to enchance downtown Minneapolis mass transit access; and

3. a large increase in express buses on I-35W from suburbs south of Minneapolis as part of the I-35W Urban Corridor Demonstration Project (see Figure III-4) - a ramp metering and bus prioritization project begun in the fall of 1972.[1]

Transit ridership in the Twin Cities area had declined 33 percent between 1950 and 1970 but rose 40 percent between 1970 and 1977.[2] The percentage of people entering the CBD by bus between 6:30 a.m. and 6:30 p.m. rose from 16.5 percent in 1970 to 23.9 percent in 1975 and to 26.9 percent by 1977.[3] This is despite the fact that Minneapolis' population declined 10 percent in the 1960's while its suburbs grew from 24 percent to 42 percent of the metropolitan population. Only about 5 percent of all trips within the Twin Cities metropolitan area are now to the Minneapolis CBD.[4]

Buses make up only 2 to 3 percent of all vehicles entering the CBD; over 80 percent of these vehicles are automobiles.[5] The public transit system serving downtown Minneapolis consists only of buses. Express buses make distribution loops in the CBD core rather than distribute passengers at one central terminal. This distribution system and the concentration of all buses on the streets has led to the consequent susceptibility of Minneapolis transit to traffic congestion.

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[1]See Final Report For The I-35W Urban Corridor Demonstration Project, August 1975, prepared for the Urban Mass Transportation Administration, Washington, D.C.

[2]Metropolitan Council, TSM Plan, September 1978, Page 13, St. Paul, Minnesota.

[3]Traffic Engineering Division, Public Works Department, City of Minneapolis, Central Business District 1977 Cordon Count (hereafter: "Cordon Count").

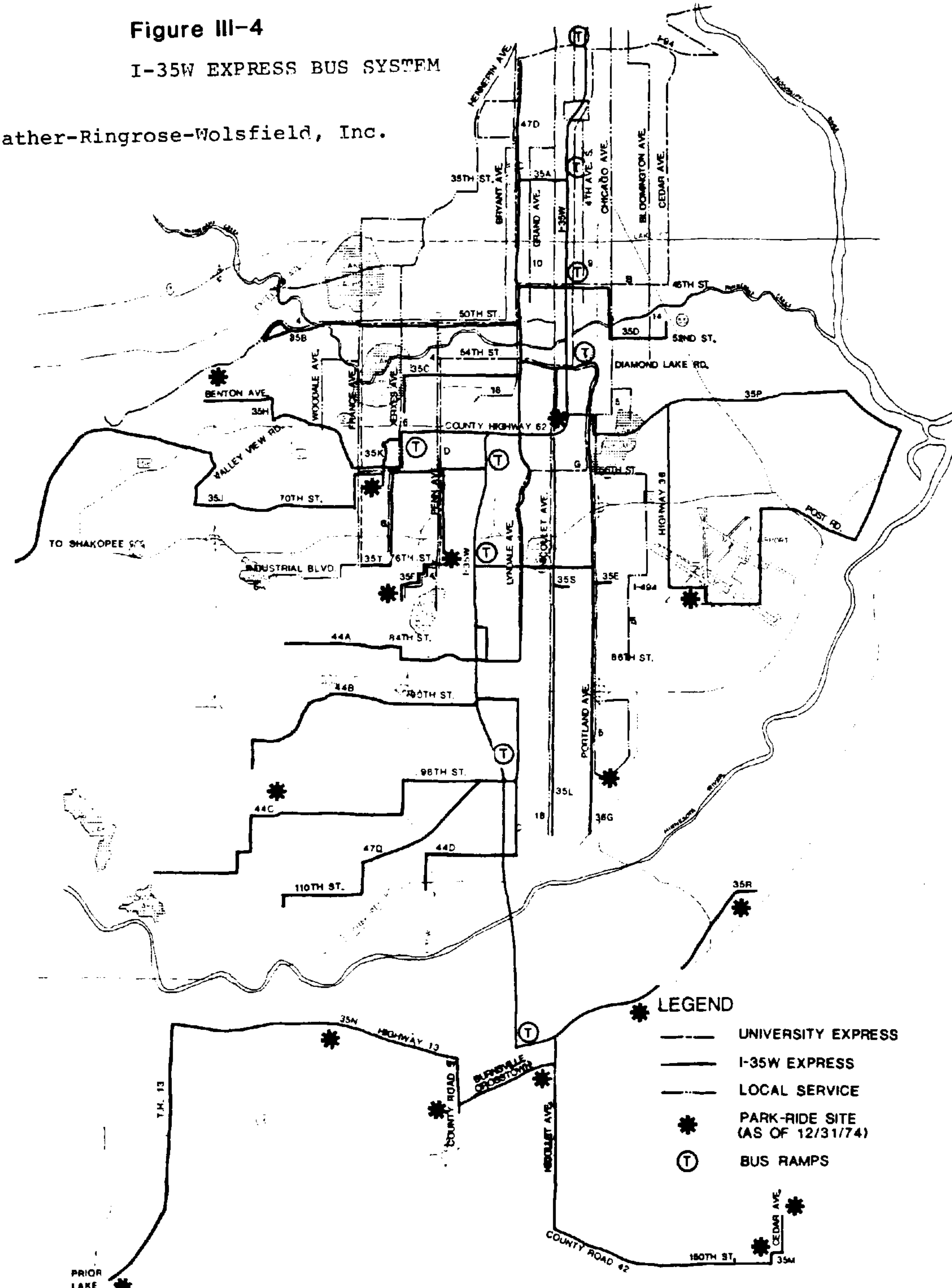
[4]Office of Technology Assessment, United States Congress, An Assessment Of Community Planning For Mass Transit, Volume 7, Minneapolis-St. Paul Case Study: March 1976, Washington, D.C.

[5]Cordon Count.

Figure III-4

I-35W EXPRESS BUS SYSTEM

Bather-Ringrose-Wolsfield, Inc.



The City of Minneapolis had generally sought to reduce automobile use in its CBD and create a better pedestrian environment. Bus and taxi service were recognized as ancillary to these ends. The Nicollet Mall and the contra-flow lanes on Marquette and Second Avenues are examples of this policy. Second floor enclosed pedestrian bridges, or "skyways", link major offices, department stores, banks, and hotels in the CBD, providing an exclusive pedestrian right-of-way.

The proposal for the Marquette and Second Avenue bus lanes was first introduced for consideration by the Minneapolis City Council in July 1973 in the form of a report by Gregory Finstad, Traffic Engineer. The city traffic engineers had analyzed many options to facilitate CBD bus movement in cooperation with the Metropolitan Transit Commission (MTC) and its predecessor, the Twin City Lines. The case for a contra-flow, as opposed to a with-flow lane, was reinforced by Minneapolis' unsuccessful experience with a with-flow bus lane on Hennepin Avenue in 1954. That lane was dropped largely because of the conflict with right-turning vehicles.[1]

The July 1973 report presented to the Council advised against a with-flow right hand lane because problems with right turns from other traffic would require a ban on right turns; such a ban was rejected as too restrictive. Use of the median lane was likewise rejected because it was felt that wide concrete medians on either side of this lane would have to be constructed which "...would not leave sufficient roadway area on either side of the concrete median to provide movement of through traffic and accommodate activity that takes place at the curb and sidewalk areas." Therefore, a left hand contra-flow lane was recommended.[2]

The left hand contra-flow lane concept as contained in the July 1973 Finstad report underwent several modifications.

<u>With-Flow Versus Contra-Flow</u>

First, the City Department of Public Works (DPW) decided to go with with-flow right hand lanes with right-turn bans instead of contra-flow lanes.[3] The reasons: expediency and

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[1] Gregory Finstad to M. Cunneen, April 1981.

[2] Gregory Finstad, Traffic Engineering Division, Department of Public Works, City of Minneapolis, "Exclusive Bus Lanes For Minneapolis: A Proposal"; July 1973, Minneapolis, Minnesota (hereafter: Finstad, 1973).

[3] Traffic Engineering Division, Department of Public Works, City of Minneapolis, "Revised Recommendation of Proposal To Establish Exclusive Bus Lanes On Second Avenue and Marquette Avenue South In The Reverse Direction," March 1974 (hereafter: DPW, 1974).

safety. The DPW wished to avoid extensive modifications to signs and signals for what was proposed merely as a two-month experiment, including an informational advertising campaign. The righthand lanes were already de facto bus lanes in the peak hour. However, the DPW went back to its original contra-flow proposal when directed by the City Council Committee on Transportation and Property Services. There was considerable opposition to banning right turns from Marquette and Second Avenues.

Double Laning And Directional Divider

Secondly, it was decided that 18-20' of contra-flow lane width must be provided, not 10' as proposed, to allow bus passing, a MTC prerequisite.

Originally, the DPW had felt that a 6' concrete median would be necessary to divide with- and contra-flow lanes on a permanent basis. Access from the contra-flow sides of the avenues would be maintained by providing gaps in this concrete median in front of driveway openings. However, when the City decided that only a double contra-flow lane of 18-20', not 10', would work, they realized it was impossible to have both a 6' median and three with-flow lanes. The width was not available. Therefore, it was decided that a one-foot mountable barrier would suffice as a permanent median, not a 6' concrete median as originally proposed. In the experimental stage the contra-flow lane would be divided from other lanes by double yellow lines and orange highway cones.[1]

Taxi and Truck Use of Contra-Flow Lanes

It was decided to allow taxis at all times. Commercial vehicles were allowed to use the lanes for local delivery and pick-up at all times other than peak periods (7:00-9:00 a.m. and 4:00-6:00 p.m.) With the elimination of all automobile curbside parking and standing, delivery vehicles were aided by the institution of the contra-flow lanes.

Under the original DPW proposal, it was expected that passenger pick up and discharge, and truck loading and unloading could take place on the concrete median (southeast side) of Second Avenue at off-peak periods only, while no loading/unloading could take place at any time on the median (northwest side) of Marquette Avenue, so that "...materials loading and unloading would be permanently prohibited."[2] The proposal would have made shipment difficult and dangerous on the southeast side of 2nd Avenue by banning trucks there in peak periods, and requiring shipments to be handtrucked over three

[1]DPW, 1974.
[2]p. 8, Finstad, 1973.

curbs and across a 10' bus lane to and from the sidewalk. There was an additional problem; there would be only three with-flow lanes which through traffic could use, competing with commercial vehicles pulled to the curb. It was anticipated that in off-peak periods trucks would be parked on two of these three lanes, along the right hand curb and along the left hand median next to the contra-flow lane. Taxis also would be stopping in these left and right hand lanes. This would reduce Marquette and Second Avenues to one-lane operations.

For these reasons it was decided to double-lane the contra-flow portion and allow commercial vehicles to park along the contra-flow curb for delivery and pick up in off-peak hours. Their presence in the lane would be no obstacle to the small volume of off-peak buses, which could pass them. Under this arrangement, parked commercial vehicles would block neither the contra-flow buses nor the with-flow traffic. Yet loading/unloading operations would be easier than before as trucks would not have to compete with autos for parking spaces. Taxis, a small component of the traffic stream, would be permitted at all times.

Parking

Under the original DPW proposal of July, 1973, there would be no standing allowed at any time on the median side of Marquette. Standing would be permitted at all times except 7-9 a.m. and 4-6 p.m. but parking banned on the other side of Marquette and on both with-flow sides of Second Avenue. Under the final DPW plan (July, 1974) this was modified to reflect double laning and taxi and truck use of the contra-flow lanes. No parking was permitted at any time on either curbside (right hand) or median side (left side) of the with-flow portions of Marquette and Second Avenues. No standing was permitted on the with-flow median sides at any time nor on either with- or contra-flow curbsides 7-8:30 a.m. or 3-6 p.m. However, truck pickup and delivery was permitted on both with- and contra-flow curbside lanes on both avenues in nonpeak hours. Small businesses along the avenues tended to disfavor the project as they felt much of local business volume depended upon people using curbside auto access. The City Traffic Engineering Division argued that this was a fallacy.

Length of Project

As originally conceived, the reverse flow lanes would extend on Marquette and Second Avenues from 2nd to 12th Streets. This was shortened in the DPW revised plan (March 1974) to 3rd to 10th Streets. However, in the modified plan which was eventually implemented, this was lengthened to 1st to Grant on Marquette, and 1st to 12th on Second Avenue. Subsequent to implementation, the northernmost two blocks were eliminated as exclusive bus lanes and became regular two-way streets. The lanes are now approximately 5,000' long on Marquette and 4,500' on Second.

Other Elements in Formulation of Plan

Since the original presentation of the proposal in July, 1973, the plan underwent modification both within the DPW and externally by changes determined by the Transportation and Property Services Committee of the Minneapolis City Council. This City Council Committee was the key decision maker in the planning stage. The Committee referred the DPW's March, 1974 request for with-flow bus lanes to the Minneapolis Downtown Council, a CBD business and labor association. In several meetings with the Downtown Council and the Building Owners and Managers Association, objections to the DPW proposal over banning right turns, truck delivery problems, and auto access to avenue buildings were voiced. In response to these objections, the Committee turned down the DPW's proposal and directed the preparation of a detailed program to establish contra-flow bus lanes. The DPW's final plan was framed by the Committee's decision.

The final DPW plan for a 90-day experimental contra-flow, double-lane project on Marquette and Second Avenues was presented to the Committee in July 1974. To implement these experimental lanes this plan outlined several changes. First, the downtown bus loops of the I-35W express buses and local routes had to be reversed. Second, reverse-facing signal faces would have to be retrofitted to traffic signals and, in some cases, new foundations would have to be installed for new signals. Given the temporary, experimental nature of the lanes, signal synchronization would not be changed to favor buses. Preemption of signals by buses, also suggested in the original DPW proposal, would be indefinitely postponed. Third, about 150 parking meters were to be removed from the affected portions of Marquette and Second Avenues. Fourth, many changes in signing had to be implemented to inform motorists and bus drivers of the new situation. Of particular concern were motorists entering the avenues from side streets and mid-block buildings who would not be anticipating two-way traffic. They could possibly enter the contra-flow lane. Fifth, a week of publicity was deemed necessary to inform people beforehand of the impending change.

In preparation for the 90-day experiment slated for September 1974, the Urban Mass Transportation Administration (UMTA) offered free staff and computer time validating their Urban Traffic Control System (UTCS) computer simulation program by means of a real demonstration. Many preparatory studies were made, especially a March-April 1974 study by the USDOT's Transportation System Center (TSC); the purpose was to calibrate a CBD traffic simulation model applicable to reverse flow bus lanes. The TSC also made "after" observations in the autumn. During September 17-19, 1974, the DPW Traffic Engineering Division and the Metropolitan Transit Commission (MTC) measured vehicular and bus travel times, bus dwell times, and traffic volumes to be compared to "after" measurements of October 15-17. Curbside standing and stopping studies had been conducted in January 1974 and were to be repeated in November.

Several problems were left unresolved until the 90-day experiment had actually taken place and the lanes were evaluated. The first was automobile access to buildings fronting the contra-flow lanes--especially parking garages, hotels, banks, and clubs. Prominent among these is the IDS (Investors Diversified Services) Center, which includes the Marquette Inn, and the Minneapolis Athletic Club. These institutions were of the opinion that patrons would be inconvenienced by the lanes; several had poor or circuitous side street entryways. Second, the installation of any permanent structures, such as bus stop shelters, concrete barriers, or mid-block signalized pedestrian crossings, would have to be postponed until it could be determined if the contra-flow arrangement would become permanent. These had all been part of the original DPW proposal.

The contra-flow lanes were instituted on an experimental basis on September 9, 1974. They continued for two years on this experimental basis with bus routes officially designated as "detours." In this period, the pre-implementation process of public meetings and professional analysis of the project continued. The police, concerned about traffic and pedestrian safety, and the business community, concerned with loss of business and automobile access, were part of this participation process from the beginning. Their views lead to modifications being made to the original plan. This does not mean the contra-flow lanes now meet with universal approval. The Director of the Downtown Council believes most businesses along the contra-flow lanes would like to see them go away but have no great difficulty with them continuing.[1] The lanes were made semi-permanent in 1976; one-foot mountable concrete median dividers were installed between contra-flow and the with-flow traffic.

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[1]O.D. Gay, Executive Director, Downtown Council, to M. Cunneen, April 1981.

III. PROJECT IMPACT AND DEVELOPMENT

Buses

It was anticipated that a 50 percent decrease in bus travel time on Marquette and Second Avenues, during the peak periods, could be achieved by use of the contra-flow lanes. The figure realized was roughly 20 percent, or a little over one minute saved per bus trip.[1] This was not sufficient to change any bus schedules or reduce operating expenses by more than a negligible amount. However, the lanes have made it easier for buses to keep to their schedules, protecting them from occasional long traffic delays which they might otherwise encounter.

The number of buses operating on these lanes has been increasing and is projected to continue to grow. In 1975, there were 49 peak hour buses on 2nd Avenue and 115 on Marquette; MTC projects that by 1985 there will be 74 on 2nd and 178 on Marquette. By October 1975, 50 percent of those leaving the Minneapolis CBD were doing so by bus.[2]

Bus ridership on routes which run on the contra-flow lanes grew by 7 percent during the 90-day trial period, though other factors accounted for part of this increase such as the continual growth of the I-35W service, gasoline cost, etc. A MTC survey found bus riders favoring the contra-flow scheme by 63 percent to 17 percent.[3]

There are presently 113 peak hour buses on Marquette carrying more than five thousand people in the peak hour, a situation the MTC feels approaches capacity.[4] The contra-flow lanes have worked well for buses and bus passengers--too well in the view of those who see "wall-to-wall" buses at rush hour on these lanes and the pedestrian crowding on the sidewalks.

Right-of-way Problems

One conclusion which City and MTC observers drew was that the lanes were too narrow, necking down to 10' adjacent to

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[1] P.1, Traffic Engineering Division, City of Minneapolis Public Works Department, Reverse Flow Bus Lanes, Second and Marquette Avenues, Final Report: Februry 28, 1975; Minneapolis, Mn. (hereafter: DPW, 1975).

[2] P. 25, Dalton, Dalton, Little, and Newport, Inc. (Cleveland, OH) and Ellerbe Associates (Bloomington, MN), Final Report Improving Transit Operations and Facilities in Downtown Areas, City of Minneapolis, Report #76-07; Oct. 1976, St. Paul, MN. (hereafter: Dalton).

[3] Pgs. 36 and 40, DPW, 1975.

[4] Aaron Issacs to M. Cunneen, April 1981.

with-flow left-turn pockets. At this width, buses tended to pound the sewer grates and to roll over the median in passing maneuvers.[1] The new Hennepin Avenue contra-flow lane is never less than 14' wide. MTC officials said that the occasional intrusion of buses into with-flow traffic lanes has not caused accidents despite the head-on conflict between buses and autos.

The one-foot median barrier does present a problem for snow ploughing and street cleaning--either ploughs or brushes must be partially raised or they must avoid the barrier.[2]

Traffic

An important objective of the project was to avoid worsening traffic congestion holding any reduction in vehicular flow to a miniumum. It was hoped that many motorists would shift to buses or drive on other avenues. According to observations of the City's Traffic Engineering Division, this objective was largely met. Apparently, about 10 percent of the traffic diverted to Hennepin and 3rd Avenues, which have sufficient capacity. P.M. peak traffic volumes decreased 9.3 percent on Marquette and 15.4 percent on Second Avenue. City Traffic observations detected a less than 5 percent increase in automobile travel time on these segments such that "... traffic flow remains at the same level of service after the lanes were started as it was before."[3] By removing curbside parking from auto use, the project aided traffic flow on some links. The average vehicular speed on Second Avenue in the p.m. peak hour prior to the establishment of the reverse flow lanes was 8.9 m.p.h. in 1972 and 10.5 in 1973. It rose to 10.8 after the contra-flow lanes were instituted. There are some traffic problems at midday, when right-hand curbside freight activity reduces the number of moving lanes down to two. The large number of left turns, first witnessed most profoundly during the pre-Christmas shopping season in 1974, prompted the City to institute left-turn pockets approaching some intersections (see Photograph III-1). It was the institution of these left-turn pockets which reduced the contra-flow width down to 10'.

Safety

There is no pattern indicating any change in pedestrian accidents because of the lanes. Pedestrian accidents on the affected portions of Marquette and 2nd Avenues have been: 7 (1972), 8 (1973) 7 (1975), 9 (1976), and 8 (1977) in the

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[1] Issacs to Cunneen.
[2] Ray Neetzel, MTC, to M. Cunneen, April 1981.
[3] Letter, C.A. Sorenson, Director of Public Works, Minneapolis DPW, to City Council Transportation and Property Services Committee, November, 19, 1974.

October-January period. Traffic accidents have increased slightly in the October-Janaury period from 26 (1972) and 29 (1973) to 40 (1974), 36 (1975), 28 (1976), and 32 (1977). However, this is statistically insignificant.[1]

Taxi and Truck Operations

While taxi and truck operations were only incidental to the contra-flow lane project, and were not originally part of it, they were the modes which benefitted the most from it. Taxi and truck CBD circulation became easier because they were exempted from the one-way traffic system and had to traverse fewer links. Trucks and taxis retained the right of access to buildings on both sides of Marquette and 2nd Avenues, yet did not have to compete with automobiles for parking and standing places along these curbs. Observations before and after the project was implemented noted an increase in off-peak truck use of the reverse-lane curb, and a 50 percent decrease in such use for the peak hours. (U.S. Postal Service vehicles were subsequently exempted from the peak period truck ban.) There was a 30 percent decrease in vehicle pick up and delivery of passengers along the contra-flow lane curb during this period.[2] Commercial vehicles have more than enough room on the lane to load, unload, stand, or move (see Photograph III-2).

Operational Changes

In the course of actual lane operation, several modifications had to be made. Most were minor matters such as the installation of more signs, relocation of bus stops and the movement of cones to allow access to property. Some major changes also were put into effect. During the Christmas shopping season, which came soon after the establishment of the lanes, heavy left-turning traffic necessitated the creation of left-turn lanes at some intersections. Left-turn bays were also established within the contra-flow way at some intersections. To compensate for the loss of curbside access to buildings on the left-hand side of Marquette and 2nd Avenues, new side street loading and parking zones had to be created (U.S. Postal Service vehicles were exempted from the peak period truck ban). Given the lower traffic volumes at night and the desire for

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[1] Pgs. 33-36, DPW, 1975 and letter, Richard Smith, City of Minneapolis Department of Pulbic Works, to M. Cunneen, June 10, 1981.

[2] P. 40, Downtown Minneapolis Bus Lanes Study Committee and Barton-Aschman Associates, Committee Report: A Study of Alternatives to Reverse Flow Bus Lanes in Downtown Minneapolis; February 1976; Minneapolis, MN. (hereafter: Alternatives Study); and Sorensen letter of October 19, 1974.

convenient curbside access for night workders, the "NO PARKING ANYTIME" right-hand curb regulation was changed in November 1974 to "NO PARKING 6 A.M. - 6 P.M."

The largest operational change involved reverting to normal two-way traffic operation on the northernmost two blocks of both the Marquette and 2nd Avenue contra-flow lanes from 1st to Washington Streets. This action was needed to provide access to the Towers Apartments. This change had little effect on bus travel time or operations.

Yet to be implemented is the bus signal preemption system. However, as part of the permanent implementation of the lane, loop detectors and electrical hook-ups were installed on 2nd and Marquette Avenues to permit such preemption. The system will not be activated until the City has finished its comprehensive computerized signalization for the entire CBD.[1]

Building Access: The Recurrent Problem

The only unresolved problem is the difficulty of automobile access to many buildings along the contra-flow lanes. For the northernmost two blocks of the corridor this problem was solved by allowing all traffic, without restriction, into a widened contra-flow lane (normal, two-way traffic). However, complaints are still heard from garage operators who regard the contra-flow lane as a barrier to direct automobile access to garages. This problem is difficult to resolve. If the contra-flow lane is opened to automobiles seeking access, enforcement would be required to ensure that auto through movement and parking does not take place. Given the unrestricted taxi access to these buildings and the ability of automobiles to pull up to discharge or pick-up passengers at the median and on side streets, the access problem is not generally viewed as significant. However, automobile patrons of the Marquette Inn, the IDS Center, and the Minneapolis Athletic Club may not share in this view.

The most severe problem is experienced at the IDS Center, which contains the Marquette Hotel. The hotel has a loading bay, very convenient for airport and train passengers. However, only taxis and airport limousines can get into the bay from the contra-flow lane. The IDS Center also has a parking garage a short distance south of the hotel loading bay. To handle traffic, the Center must retain one or two traffic enforcement agents at the intersection formed by the IDS garage entrance, with-flow traffic, and the contra-flow lane (see Photograph III-2). The annual cost of this enforcement with

[1]Finstad to Cunneen.

one agent in 1976 was $26,816 to IDS Properties, Inc.[1] In addition, at some buildings (i.e., Pillsbury Club Mahala Fisk Building) vehicles back out into the contra-flow lane.

To resolve these problems, the Minneapolis City Council on March 27, 1975 decided to continue the contra-flow lanes on a temporary basis and asked the Downtown Council--a business, labor, and civic CBD association--to sponsor a Downtown Minneapolis Bus Lanes Study Committee including the City DPW and the MTC, to investigate alternatives. This Committee retained a transportation engineering consultant for its study.

The findings of the Committee, contained in its final report (January 1976) were that the contra-flow lanes as instituted were the best solution because they offer a reasonable compromise between automobile and bus access while facilitating taxi and delivery vehicle movement. The report offered no solution to the mid-day auto congestion problem. In particular, the report advised against:

1. any deviation of express buses from the desired destination of passengers in the CBD core--Nicollet, Marquette, and 2nd Avenues;

2. with-flow bus lanes, because they produce right-turn conflicts and greater bus circuitry;

3. transit-only streets, because of their projected underutilization and associated freight and passenger access problems; and,

4. one central, or a few fringe bus terminals, because they would unnecessarily inconvenience passengers, raise transit system costs, and remove CBD land from more productive uses.[2]

Shortly after the Downtown Bus Lanes Study, the City and MTC made another study on improving downtown transit operations and facilities. This study also concurred that the existing contra-flow was the best possible arrangement and could not find solutions to the automobile access problems at the Marquette Inn, Athletic Club, etc. However, this report did recommend a 60-second rather than a 90-second cycle, suggesting

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[1] P. 21, Dalton, Dalton, Little, and Newport, Inc. (Cleveland, Oh.) and Ellerbe Associates (Bloomington, Mn.), Final Report Improving Transit Operations and Facilities in Downtown Areas, City of Minneapolis, Report #76-07; Oct. 1976, St. Paul, Mn. (hereafter: Dalton).

[2] Alternatives Study, 1976.

that this would allow the size of block sets (bus platoons) in each cycle to increase from three to five.[1]

The initial cost of creating the Marquette and 2nd Avenue contra-flow lanes on an experimental basis is given as $24,521 in the Minneapolis Department of Public Works' final report on the establishment of the lanes. The report further explained the expenses as: far side right and left signal indications for buses; additional signs to define the contra-flow lane and change "NO STOPPING 7:00 - 9:00 A.M." to "NO STOPPING 7:00 - 8:30 A.M."; removal of lane lines at dual turn locations on the avenues and cross streets; and new lane lines.[2]

The above cost does not include the construction of the one-foot concrete median or routine maintenance of the lanes, medians, signs, lights, or enforcement of contra-flow lane regulations. Nor does it reflect the costs involved in any of the modifications to the lanes: left-turn lanes and bays, elimination of the northernmost two blocks from the lanes, side street parking and loading zone re-signing, installation of additional signs, movement of signs, or the costs of planning and communications related to the lanes.

The total capital cost of the permanent bus lanes is given by the Minneapolis DPW as $805,000, including $73,000 for re-striping of lanes and walks, $118,000 for electrical loop detector and amplifier hook-up (for preemption in computerized signal control), and $614,000 for the construction of the medians.[3]

Contra-Flow Operation on Hennepin Avenue

Perhaps the best testimony to the efficacy of the contra-flow experiment in Minneapolis is that the technique has been put into effect elsewhere in the Minneapolis CBD. Beginning in September 1980, Hennepin Avenue, the fourth major CBD artery a block west of the Nicollet Mall, was given similar contra-flow lane treatment. The Hennepin lane is still temporary and marked by oil drum and highway cone dividers. Much of the impetus to create the Hennepin lane came from air quality analyses by the State which classified the Hennepin and 7th Street intersection as a pollution "hotspot." The City's response was to turn Hennepin and 1st Avenues into a one-way couplet. Hennepin, largely an entertainment street on the CBD edge, has considerable traffic problems on weekend nights. Learning from the experience of the Marquette and Second Avenue contra-flow lanes, the Hennepin lane was made 14' wide at its narrowest point, not 10'

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[1]Pgs. 21-23, Dalton.
[2]Pgs. 40-41, DPW, 1975.
[3]Finstad to Cunneen.

The MTC is presently trying to interest the City of St. Paul in contra-flow operations on several narrower downtown streets with heavy bus volumes--5th, 6th, Minnesota, and Cedar.[1]

[1]Isaacs and Neetzel to Cunneen.

IV. PROJECT ANALYSIS

A. Lane Operation

Presently, the contra-flow lanes at the peak period operate as nearly solid walls of red buses in block sets of four or five buses. The 90-second cycle allows a block set of buses to shift one block over per phase with approximately enough time to load up with passengers and prepare for the next phase. Blockfaces are typically 330' long.

The consultant recommendation that the avenue cycle length be shortened from 90 to 60 seconds has not been implemented because the City did not agree that it would actually expedite the flow of buses. The idea behind a 60-second cycle was to move a greater number of buses in the peak hour by eliminating the time buses spend waiting for green signals after the buses are loaded within the 90-second cycle. The consultant felt that 60 seconds was enough time for a platoon of buses to pull into the bus stop, load, and be ready to move with the next green indication. The City's observations were, however, that at several of the more congested bus stops, 60 seconds would be insufficient to enable bus passengers to "work their way through the crowd to their desired bus in a platoon and board it." The City felt that because of this, bus loading would continue into the green phase and that some buses would then be forced to wait for the next green phase to move off. This would break up platoons and the even flow of buses. It was also felt that the 90-second cycle was more efficient in moving other traffic and in generally moving the greatest number of vehicles and people with the least air pollution and congestion in downtown.[1]

B. Pedestrian Access to Buses

During the peak hour, bus riders presently wait for buses on crowded and largely unsheltered sidewalks (see Photo III-2). They have the same problem experienced by bus riders at the Los Angeles City Hall on the original Spring Street contra-flow lane (see Los Angeles section of this report); they do not know where to catch the bus. This often results in many people rushing in both directions on a narrow, crowded sidewalk, as each block set of buses settles into position, initiating a new round of something approaching musical chairs. While this problem in real life is not half as bad as it may seem in theory, it can get exponentially worse as ridership increases and sidewalk pedestrian capacity is approached.

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[1]Letter, Richard Smith, Minneapolis Department of Public Works, to M. Cunneen, June 10, 1981.

There is no simple solution. Sidewalks in downtown Minneapolis are much narrower than those of other major cities where similar bus operations have been implemented: 2nd Avenue, New York; Portland Transit Mall; and Spring Street, Los Angeles. However, sidewalk widening in downtown Minneapolis would remove one traffic lane. If this were done it would lead to an unacceptable level of service for non-bus traffic.

Buses cannot arrive in a pre-determined order because there are too many of them converging from many different routes. They begin runs from six curbside layover zones. Designated bus stops would be another procedure difficult to maintain. Even if buses could advance in a set order, the last one or two buses in each block set do not always make it to the next block in the 90-second cycle. Other buses behind them may be able to move off sooner and could pass them. Either the set order, and hence the validity of specified route bus stops is compromised, or the set order is rigidly maintained and bus passing is banned. The latter would slow operations and reduce the already strained capacity of the lanes.

MTC hopes to lessen rider confusion by a centralized terminal, to be built at Washington and 4th Streets, obviating the curbside layover zones. The terminal, which will be multistoried and have automobile parking, would create the potential for more efficient bus dispatching and operations management. Centralized terminal dispatchment of contra-flow buses cannot, however, guarantee a set order of bus arrival at curbside without incurring service delay: halting some buses to allow others to move out first, or waiting for buses delayed by traffic to maintain a set order of exit from the terminal. The present "first come, first served" system assures a rather uninterrupted flow of bus movement, and maximizes bus productivity.

A longer term solution for the future, which the MTC is considering, would be a "Bus Alert" system based on electronic passive detection and identification of individual buses. This system could be hooked up to a computer, which in turn could transmit the signal to electronic display panels, indicating the route number of the next bus or next several buses to stop in that space. This could permit passengers to wait inside buildings (see Figure III-5). Capital costs of such a system now are considered prohibitive.[1]

Another option to permit better access of pedestrians to buses and across streets was the installation of mid-block pedestrian signals. However, it was not implemented because experience with mid-block pedestrian signals on the Nicollet Mall showed that pedestrians ignore these signals (the signals have

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[1]Neetzel to Cunneen.

Figure III-5 : CONCEPTION OF AN INTERIOR MALL "BUS ALERT" SYSTEM
Dalton, Dalton, Little, & Newport, Inc.

subseqently been removed from the Mall). In addition, the expensive installation and operation of such signals would also be of no benefit to vehicular movement and would tend to decrease the vehicular capacity of the avenues.

Such mid-block crossings across the avenues have also been made redundant by the construction of second-floor pedestrian bridges or "skyways." Existing skyways, which can easily be reached from the sidewalk through buildings, cross over Marquette Avenue on the three blocks with heaviest passenger demand between 5th and 8th Streets. More skyways are proposed on the next two southward blocks as well as across Second Avenue at seven mid-block locations (see Figure III-6). The skyway system, plus several mid-block pedestrian tunnels, constitute an all-weather interior CBD pedestrian circulation system. When completed, a person would be able to enter any CBD building and walk in the downtown area protected from the winter weather.

C. Future Demand and Lane Capacity

The Marquette Avenue contra-flow lane is presently nearing capacity. Capacity, with 50 percent "green" time has been estimated at 150 buses an hour. The MTC has estimated its 1985 bus volume on Marquette as 178 buses/hour; it was 115 in 1975. The MTC's estimates for increases in downtown bus volumes between 1975 and 1985 on the other major CBD avenues are: Hennepin, 73 to 110; Second, 49 to 74; and Nicollet Mall, 83 to 124. Another way of looking at this is that by 1985, MTC believes it will have to have nine buses stopping in each block set to accommodate the peak five minute demand (4:40-4:45 p.m.) on Marquette Avenue.[1] This would be a rather tight squeeze-- 36.5' per bus!

As the above situation is not feasible, either the peak demand must be spread, or bus loading capacity increased. The peak demand as of 1976 was very concentrated--a sixth in the fifteen minutes.[2] A temporal spreading of demand may occur naturally as a response to intolerable sidewalk and bus crowding in the peak fifteen minutes. The demand on Marquette can also be lessened by shifting some bus routes to cross-streets. Given the spatial concentration of employment, along 5th, 6th, and 8th Streets (see Figures III-7 and III-8), and Marquette's space limitations, this is likely to occur. There are other ideas to increase capacity. One is to speed up passenger loading operations by opening rear doors and have payment when passengers alight from the bus, instead of payment when boarding. This procedure is already in effect on the I-35W express buses.

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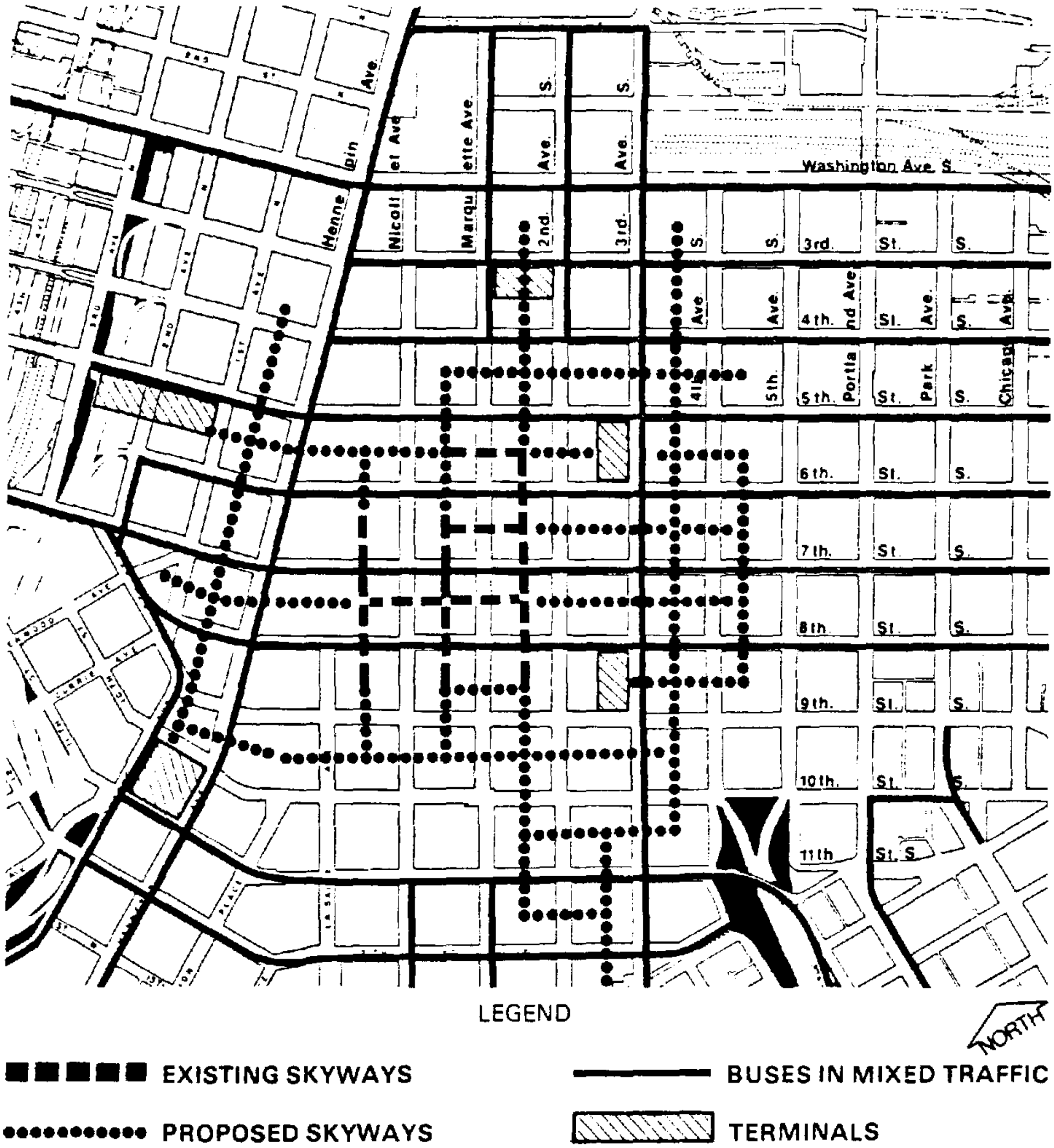
[1]P. 25, Dalton.
[2]Ibid., p. 1.

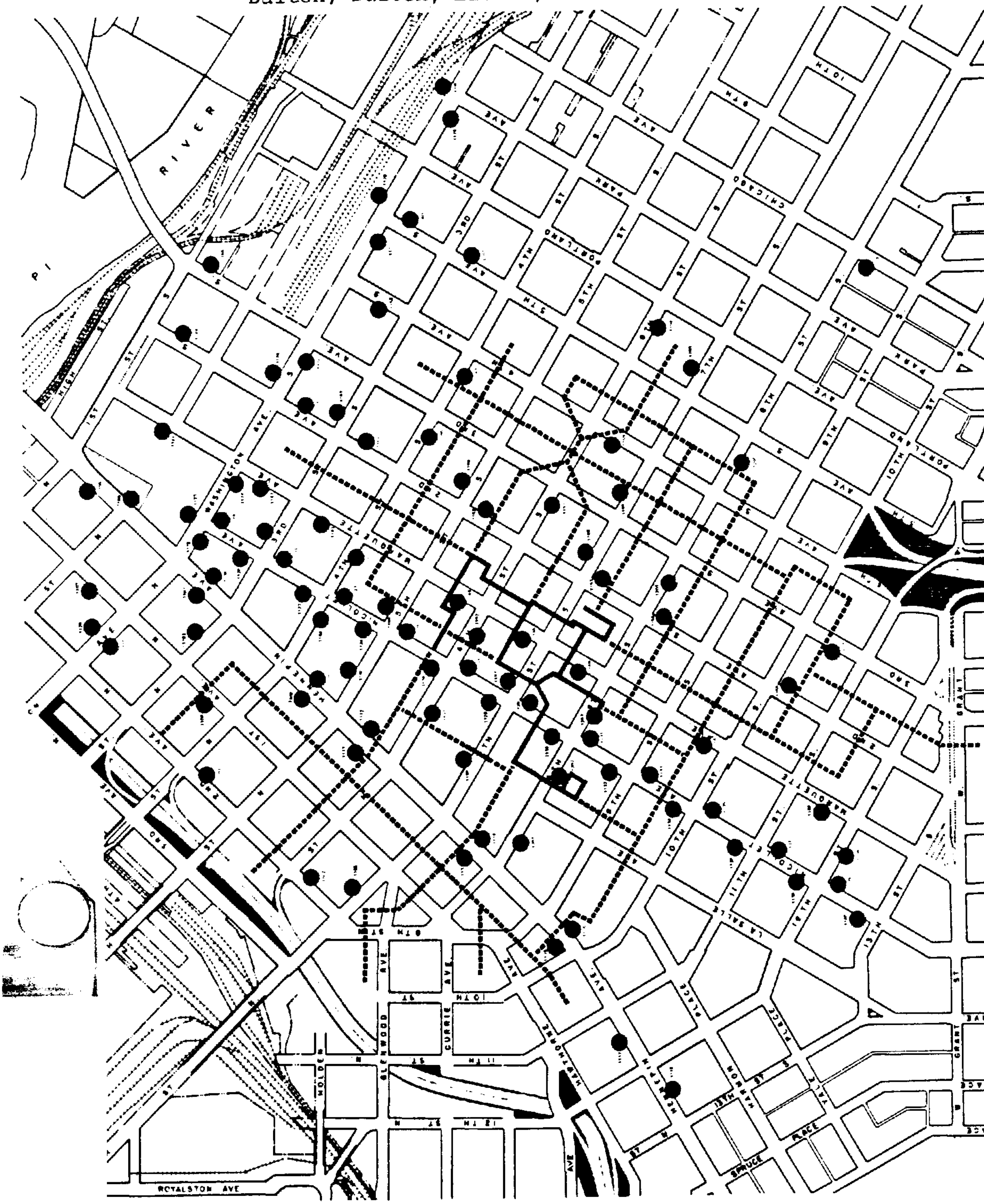
Figure III-6 : DOWNTOWN MINNEAPOLIS SKYWAY SYSTEM

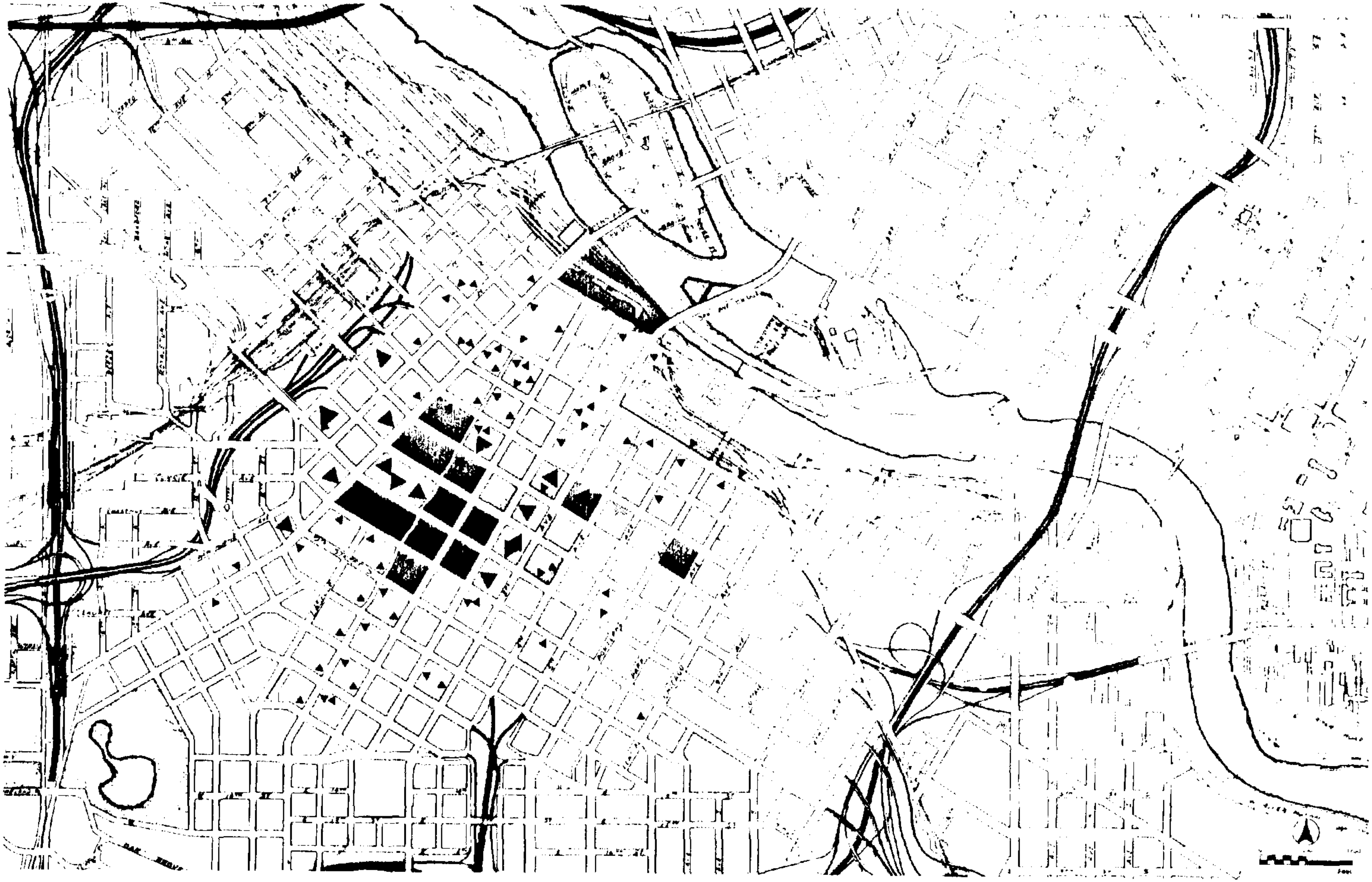


From Figure 28, Committee Report, A Study of Alternatives to Reverse Flow Bus Lanes in Downtown Minneapolis 1976.

Figure III-7 : BUS STOPS & SKYWAY SYSTEM, MINNEAPOLIS CBD

Dalton, Dalton, Little, & Newport





Employment/Block
- 0 TO 500
- 501 TO 1000
- 1001 To 3000
- 3001 To 5000
- 5001 +

- ▲ Bus Stops Under 100/Peak 5 Minute Period
- ▲ Bus Stops Over 100/Peak 5 Minute Period

Employment data are 1985 projections. Loadings are indicated for the recommended plan in 1985.

FIGURE III-8:

Evening Peak Bus Stop Loadings Downtown Minneapolis

Dalton, Dalton, Little, Newport

Another is the use of higher capacity (articulated or double-decker) buses, which reduce dwell-time per passenger, as well as vehicle space requirements per passenger.

V. CONCLUSIONS

The Marquette and Second Avenue bus lanes are the most successful of the four bus lane projects described in this report. They provide faster movement for buses, allow for bus passing, do not seem to be a safety problem, permit off-peak commercial vehicle operation in the lanes, and make the most efficient use of space of any of the TSM projects reviewed in this report.

The development of this project is in many ways a model. A plan with a single-minded purpose--moving buses--was brought forth. In a long process of public discussion and analysis which brought in all the key downtown elements--the bus operator, the police, the city traffic engineers, business, labor, and the City Council--the original plan was modified and in several ways improved. It was originally a plan only for bus movement, integrated with the establishment of a computerized signalization system. It developed into a comprehensive CBD plan to facilitate taxi and freight vehicle operations as well, with proper consideration to public utility underground work, pedestrian access, traffic flow, and a bus signal preemption system. The Minneapolis project was entirely sound from a traffic engineering viewpoint and was developed by the professional traffic engineers responsible to the City government. The nagging problem of automobile access to buildings along the contra-flow lanes was minimized. Freight access by commercial vehicles and direct passenger access by taxi or bus was provided.

Another aspect of this project reflects how much it underlines the value of TSM projects which can be modified easily and incrementally, based on need and operational experience. It was possible to operate the project on an "experimental" basis for two years with only $25,000 (1974 dollars) as capital investment and with no extra operating personnel. During those two years enough was learned to test the impacts of the lanes, make several modifications, and plan a final design which was efficiently integrated with an innovative CBD transportation system--the pedestrian skyway network--and computerized signalization. Minneapolis took over a year of planning and two years of actual operating experience before they finally invested $805,000 (1976 dollars) to put the project in final form. By that time everyone there knew precisely what they were spending the money on.

Another notable feature of this project from its inception has been its planning integration, dovetailing into CBD plans for: pedestrian circulation in exclusive, sheltered rights-of-way (skyways and tunnels); and interior pedestrian malls (see Figure III-5)--Minneapolis' largest pedestrian mall in the IDS Center opens onto both the Nicollet Transit Mall and the Marquette Avenue contra-flow bus lane; a CBD computerized signal system with bus signal preemption; continued concentration of employment and shopping along Nicollet, Marquette and Second Avenues; commercial viability of the CBD with unhampered freight operations; and a street system that can deliver 5,000 people per lane per hour to maintain downtown as a concentrated, high density center.

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8. Metropolitan Council, 1980-84 Transportation Improvement Program, Twin Cities Metropolitan Area; December 1979; St. Paul, Minnesota.

9. Office of Technology Assessment, United States Congress, An Assessment of Community Planning for Mass Transit, Vol. 7 (Minneapolis-St. Paul Case Study), March 1976.

10. Dalton, Dalton, Little, & Newport, Inc. (Cleveland, Ohio) and Ellerbe Associates (Bloomington, Minnesota), Final Report, Improving Transit Operations and Facilities in Downtown Areas, City of Minneapolis; (Report 76-07) sponsored jointly by the Cities of Minneapolis, St. Paul, and Metropolitan Transit Commission, October 1976, St. Paul, Minnesota.

11. Traffic Engineering Division, Minneapolis Public Works Department, Central Business District, 1977 Cordon Count (Wednesday, September 14, 1977, 6:30 a.m. - 6:30 p.m.)

12. Ann Musyka, "Bus Priority Strategies and Traffic Simulation," Better Use of Existing Tranportation Facilities, (Transportation Researach Bureau Report #153), 1974, Washington, D.C.

IV. SPRING STREET CONTRA-FLOW BUS LANE LOS ANGELES, CALIFORNIA

I. CAPSULE DESCRIPTION OF PROJECT

The Spring Street Contra-Flow Bus Lane, Los Angeles, California is a curbside exclusive bus lane, with contra-flow bus movement northbound against southbound traffic and passenger pick-up and delivery along the entire length. It was instituted on May 19, 1974 to expedite downtown bus operations, especially express buses traveling on the San Bernardino Freeway Express Busway. The lane extends for 12 blocks (1.4 miles) and is 12-13' wide for most of length; 21-26' wide since November 1979 for the northern 4-block segment of the lane. The bus lane forms the east side of a 5-6 lane downtown urban arterial, which also has 4-5 traffic lanes in the opposing direction. Typical southbound with-flow traffic on Spring Street is 4,000 7-9 A.M. and 2,000 4-6 P.M. 1,145 buses use the lane daily (1980); 260 4-6 P.M. (1980) on most heavily used segment. Project problems have included disappointing bus speed performance, insufficient lane width to permit bus passing of other buses stopped in lane, and interference with commercial operations. In November 1979, the most heavily used 4-block segment of lane was widened to 21-26', allowing bus passing. The agencies involved in this project were the Southern California Rapid Transit District (SCRTD), the Los Angeles Department of Traffic (later Department of Transportation), and the Southern California Association of Governments (SCAG).

II. CHRONOLOGY OF EVENTS

January 1973 - Express operation begins on the San Bernardino Freeway Express Busway between downtown Los Angeles and San Gabriel Valley suburbs. Planning underway to speed downtown ingress and egress of these buses.

March 1973 - The consultant for the Southern California Rapid Transit District releases his plan for a downtown contra-flow bus lane system on Hill, Olive, Main and Spring Streets. This plan later has to be scaled down by the Rapid Transit District to a Spring Street contra-flow lane only.

July 1973 - Busway terminal opens at El Monte as ridership grows substantially.

December 1973 - The Los Angeles City Traffic Department releases a study of its projections and traffic simulation of a contra-flow bus operation on Spring Street. They project slower bus movement and worsened traffic conditions if the contra-flow lane is implemented. They also cite the forthcoming downtown signalization changes as beneficial to existing, with-flow bus movement.

January 1974 - Downtown signalization scheme implemented, aiding with-flow movement on Spring and Main.

February 1974 - City Council approves Spring Street contra-flow bus lane over objections of Traffic Department.

May 1974 - Spring Street contra-flow lane is implemented with northbound bus routes re-routed from Main Street with traffic to the exclusive, contra-flow bus lane on Spring.

June 1974 - Survey by the Southern California Rapid Transit District of contra-flow bus lane riders finds they like it.

July 1974 - The Southern California Rapid Transit District releases its initial, positive evaluation of contra-flow operation, finding bus movement faster than before.

August 1974 - The City Traffic Department releases its negative evaluation of contra-flow operation, finding bus movement slower than before.

December 1974 - Spring Street businessmen ask for an end of the contra-flow operation before City Council committee, citing disruption to commercial shipping and parking.

May 1975 - Busway ridership has grown from 6,000 to 14,000 in the past 18 months. All these Busway riders, plus riders on many non-Busway routes, using Spring Street contra-flow lane.

1975 - SCRTD consultant releases his final evaluation of contra-flow lane performance, finding bus movement slower than before, but the lane a success for other reasons and the slower movement due to greater patronage.

1978 - Los Angeles Department of Transportation (LADOT) is formed out of the Los Angeles Department of Traffic (LADT) and other city agencies: this new department looks to improve surface transit operations in cooperation with the SCRTD.

November 1979 - Widening of Spring Street contra-flow lane between Aliso and 1st Streets is implemented with the re-routing of some bus routes onto New High Street north of the lane. This new system permits faster contra-flow bus movement by allowing buses to pass each other and skip stops.

December 1980 - The LADOT/SCRTD joint evaluation of the above is released, recording travel time and speed improvements.

III. BACKGROUND

A. The San Bernardino Freeway Express Busway

The Spring Street contra-flow bus lane in downtown Los Angeles was an attempt to improve express bus circulation, especially of buses from the San Bernardino Freeway Express Busway (see Figure IV-1). The Busway was a $61 million project, which began operation in January 1973. It is an 11-mile two-way reserved set of lanes built on old Pacific Electric streetcar right-of-way. Its westerly four miles are adjacent to the north side of the San Bernardino Freeway from the Santa Ana Freeway near downtown Los Angeles and its remaining easterly seven miles is in the median of the Freeway to the suburban El Monte Bus Terminal. The Busway, available to about 45,000 San Gabriel Valley downtown commuters, is the most complete busway in the United States. It has: two on-line stations, extensive feeder bus service, and a 1,400-car park-and-ride lot and modern terminal at El Monte. The Busway has reduced bus travel time on its length to 14 minutes, saving an average of 16 minutes in the morning peak period and six minutes in the evening peak.[1]

Daily Busway bus ridership rose from 1,200 to 14,500 by the summer of 1975.[2,3] By 1978, about 24% of the trips to the Los Angeles CBD from the San Bernardino Freeway corridor were made by bus,[4] equal to the bus share for aggregate CBD-bound trips in the metropolitan area. These gains have been in spite of fare increases from 25¢ in 1973 to $1 by July, 1977[5] (the fare was $1.85 one-way in 1981) and in spite of the fact that since October 1976 carpools with three or more persons were allowed to use the Busway. By 1978 there were as many carpoolers as bus riders using the Busway.[6]

Lacking any rail rapid transit system, Los Angeles is entirely dependent on surface bus operations. The Busway was designed to create some facsimile of rapid rail service,

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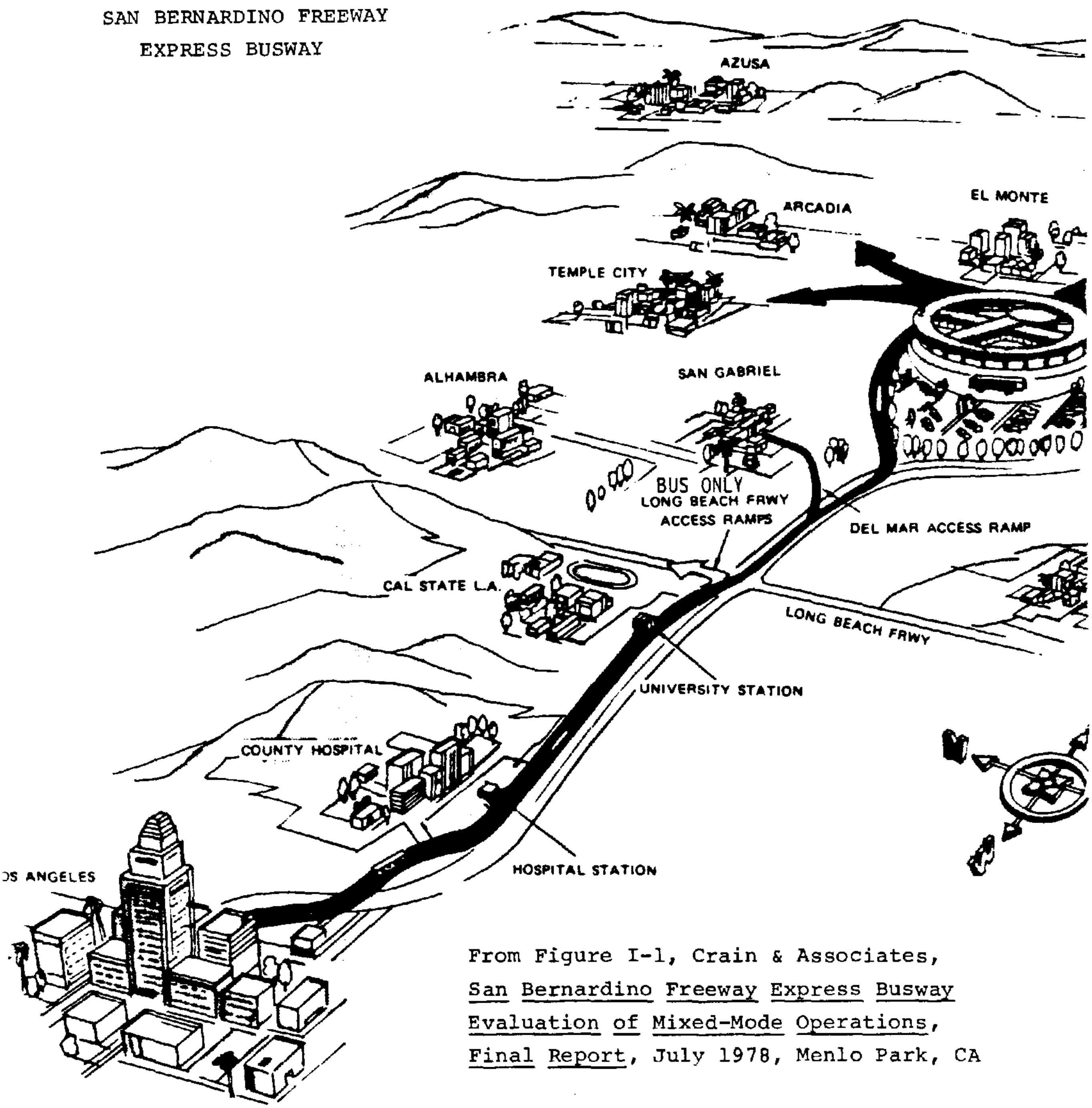
[1]Source: Crain & Associates, First Year Report, San Bernardino Freeway Express Busway evaluation, February 1974, for the Southern California Association of Governments (SCAG), Menlo Park, California; Crain-Bigelow Associates, Second Year Report, San Bernardino Freeway Express Busway Evaluation, for SCAG, September 1975, Menlo Park, California; and Crain & Associates, San Bernardino Freeway Express Busway: Evaluation of Mixed-Mode Operations, Final Report, for SCAG, July 1978, Menlo Park, California (hereafter, Crain, year of report).
[2]Crain, 1974.
[3]Crain, 1978, p. 10.
[4]Ibid., p. ix.
[5]Ibid., pp. 2 & 34.
[6]Ibid., pp. ix, x, xii.

Figure IV-1

SAN BERNARDINO FREEWAY
EXPRESS BUSWAY



From Figure I-1, Crain & Associates, San Bernardino Freeway Express Busway Evaluation of Mixed-Mode Operations, Final Report, July 1978, Menlo Park, CA allowing transit patrons to move faster than motorists into downtown Los Angeles. This kind of improved mass transit is perceived as essential to revitalize or expand downtown Los Angeles, a CBD which has not grown in trip attractions since 1920. Sixty-five percent of the downtown area is now devoted to the service, storage, or movement of motor vehicles. However, such CBD provision for auto-related space is necessary to accommodate the two-thirds of downtown commuters who arrive by automobile. The 1970 Census found that 82% of all employed residents of Los Angeles City, and 89% of all employed residents of suburban municipalities within Los Angeles County went to work by automobile. Only 9% of the city and 3% of suburban residents used mass transit.[1]

From the initial planning stages of the Busway on, it was perceived that: "The weak link of bus rapid transit is the yet unresolved problem of efficiently handling the buses in the downtown area."[2] While buses could move along the Busway at high speed, after exiting into the congested downtown street network they would be caught up in the same grinding traffic as all other vehicles at rush hour, with their added delay problem of pulling to and from the curb to discharge or pick up passengers.

B. Downtown Los Angeles

Downtown Los Angeles has two main components, a west side Commercial Core and a Civic Center of government offices to the north. The Commercial Core, located on the west side of downtown, has attracted many new businesses as well as financial and other firms migrating westwards from the older, central CBD around Main and Spring Streets (see Figure IV-2). Many large, modern, high-rise buildings have been built there. The West Side Comercial Core is bounded roughly by the Harbor Freeway on the west, Hill Street on the east, Olympic Boulevard on the south, and the Bunker Hill Urban Renewal Area (now developed as a commercial/residential complex) to the north between Hope and Figueroa Streets.

An older commercial core of lower buildings from the earlier part of this century extends eastwards to Los Angeles Street. Much of this eastern CBD is a depressed area with high vacancy rates, low land values, and declining commercial employment. The westward shift within the Los Angeles CBD in the 1970's has been pronounced.

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[1] P. 5, Office of Technology Assessment, U.S. Congress, An Assessment of Community Planning for Mass Transit, Los Angeles Case Study, March 1976, Washington, D.C.

[2] P. 2, Crain, 1974.

Figure IV-2: DOWNTOWN LOS ANGELES BUSWAY SYSTEM

Automobile Club of Southern California Map of Downtown Los Angeles

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EXPLANATION OF FIGURE IV-2

A. Buses move on exclusive Busway along north side of San Bernadino Freeway.

B. Inbound buses go straight onto ramp to Santa Ana Freeway.

C. Outbound buses exit off Santa Ana Freeway and turn north on Mission Road to reach Busway.

D. Inbound buses exit Freeway and reach Spring via Arcadia Street.

E. Outbound buses leave Spring contra-flow lane at Aliso Street, turning east.

F. Inbound (southbound) buses move with-flow on Spring Street.

G. Outbound (northbound) buses move contra-flow on exclusive contra-flow bus lane, double-width north of First Street.

H. Most buses go west to Olive Street to provide west side commercial district service, running with-flow on First and Olive Streets - no contra-flow or other exclusive bus lanes.

I. Outbound (northbound) buses move contra-flow on exclusive 13' contra-flow bus lane.

J. Inbound buses access RTD Terminal and must make circuitous loop to enter northbound contra-flow bus lane to move outbound.

The Civic Center is the other core component of downtown Los Angeles. The Civic Center had about 30,000 employees in the early 1970's and contained the highest spatial concentration of downtown workers.[1] Bounded by the Santa Ana and Harbor Freeways, 2nd and Los Angeles Streets, the Civic Center includes numerous federal, state, county, and city offices such as Los Angeles City Hall and Annexes, the U.S. Courthouse, the State Department of Transportation, the Los Angeles County Courthouse, the County Hall of Administration, the Federal Building and others.

Given this dual downtown core, the CBD distribution system for Busway buses had to pass through the Civic Center and run down some West Side street from north to south. Consideration was given to exiting Busway buses off the Santa Ana Freeway via the Hope Street ramp, and have the buses go straight down Grand Avenue under the Bunker Hill development. However, the final planning and construction of the Bunker Hill complex precluded such an arrangement, which had the disadvantgage of bypassing the major portion of the Civic Center. The eventual distribution plan (Figure IV-3) had the Busway lines operating on the one-way Spring and Main Streets couplet in the Civic Center, crossing west on First Street, then operating on Olive Street for the length of the CBD.

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[1] Wilbur Smith Associates, Downtown Distribution Plan, San Bernardino Freeway Express Busway, March 1973, Los Angeles (hereafter, Wilbur Smith, 1973).

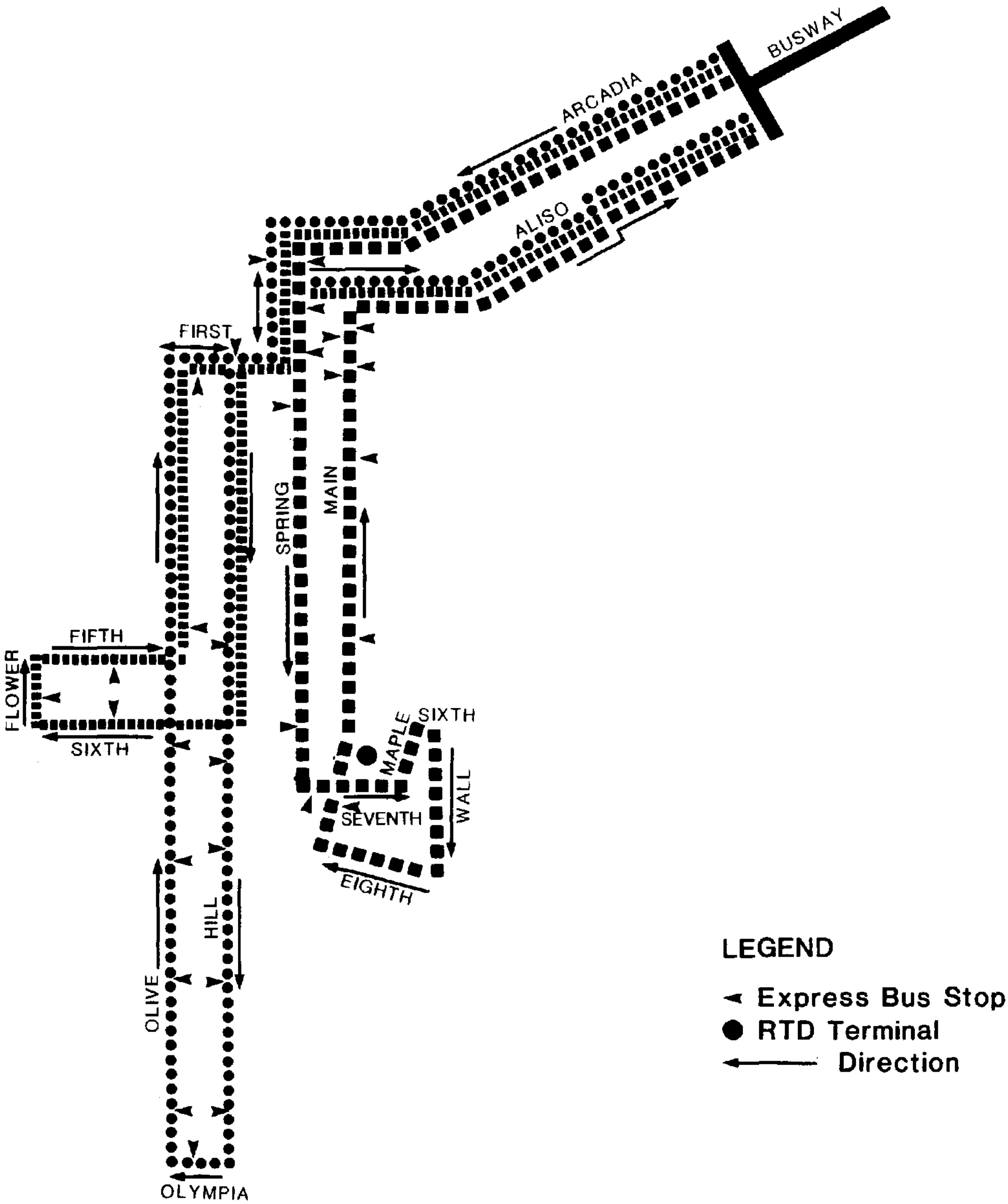

Figure IV-3 : RECOMMENDED DOWNTOWN BUSWAY DISTRIBUTION SYSTEM

IV. PLANNING AND IMPLEMENTATION

A. The SCRTD Plan

From the beginning of Busway service, the Southern California Rapid Transit District (SCRTD) considered plans to improve downtown bus circulation, especially those involving exclusive bus right-of-way. The SCRTD, the nation's largest all-bus transit operator, provides the lion's share of mass transit service in the Los Angeles metropolis and virtually all of the service on the San Bernardino Busway. The SCRTD runs most local bus service in Los Angeles as well as nearly all "Interurbans" (a term inherited from Pacific Electric trolley days for long distance express or semi-express services).

For some time it had been a goal in downtown Los Angeles to reduce traffic congestion by transforming the long two-way north/south streets into one-way couplets (as most of these east/west cross streets are). However, only two north/south streets, Main (northbound) and Spring (southbound), have been made one-way. The most likely candidates for similar one-way coupling have been Hill and Olive Streets. The SCRTD's consultant recommended the Hill/Olive one-way coupling, with the implementation of contra-flow bus lanes on these streets (see Figure IV-3) by having some Hill/Olive buses short stop, looping back at 6th Street, to Flower, to 5th Street. The consultant believed contra-flow lanes offered the best way to grant buses an exclusive right-of-way, because of their self-enforcing nature (see Figure IV-4). It was also decided that the high local bus volumes on Broadway precluded this street as a route for Busway buses and that either inadequate width, discontinuity of route, or long walking distances made Grand, Hope, Flower, or Figueroa Streets infeasible as contra-flow bus routes. However, the City was unwilling to change Hill and Olive Streets into one-way streets because of problems with driveway access to Pershing Square Garage (the long term leaseholder there threatened to sue the City if a one-way system was implemented), the cost, and capacity problems of the proposed transition roadway south of First Street. Main Street was undergoing major construction for the Civic Center Mall. Main Street was also rejected for contra-flow implementation because the westbound left turn by buses coming from the Freeway at Arcadia Street onto the west contra-flow curb of Main Street southbound would involve buses crossing two with-flow northbound lanes of Main Street. This left Spring Street as the only practical roadway for application of contra-flow.

Prior to implementation of the Spring Street contra-flow bus lane, only one of the six Busway lines--Number 60--was actually using the Main/Spring Street couplet south of 1st Street (see Figure IV-5). The other five lines--Numbers 401 to 405--were using the Main/Spring couplet for only two blocks between

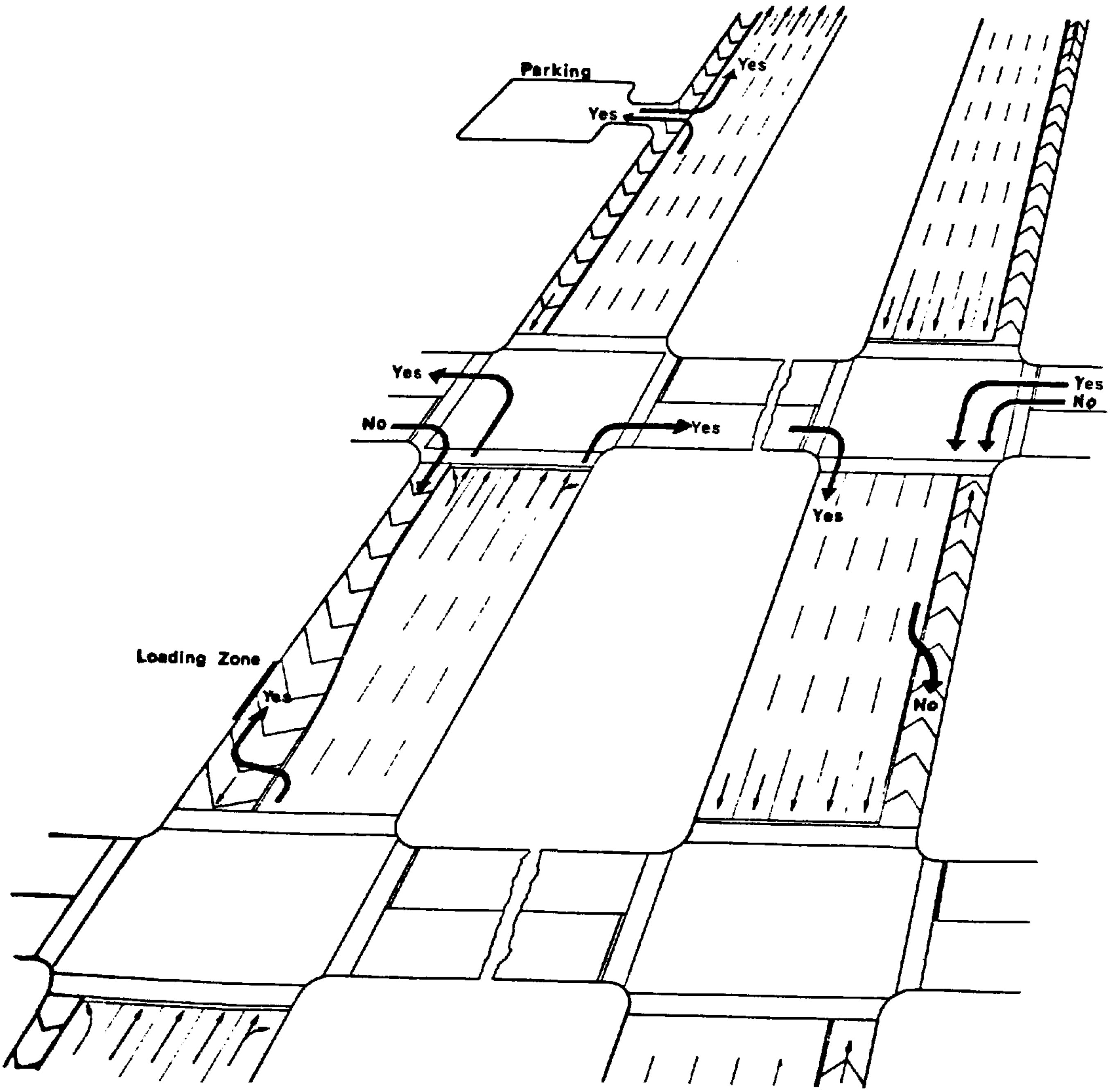

Figure IV-4
CONCEPTUAL DIAGRAM OF CONTRA FLOW OPERATION

From Figure 15, Wilbur Smith Associates, Downtown Distribution Plan, San Bernardino Freeway Express Busway, March 1973.

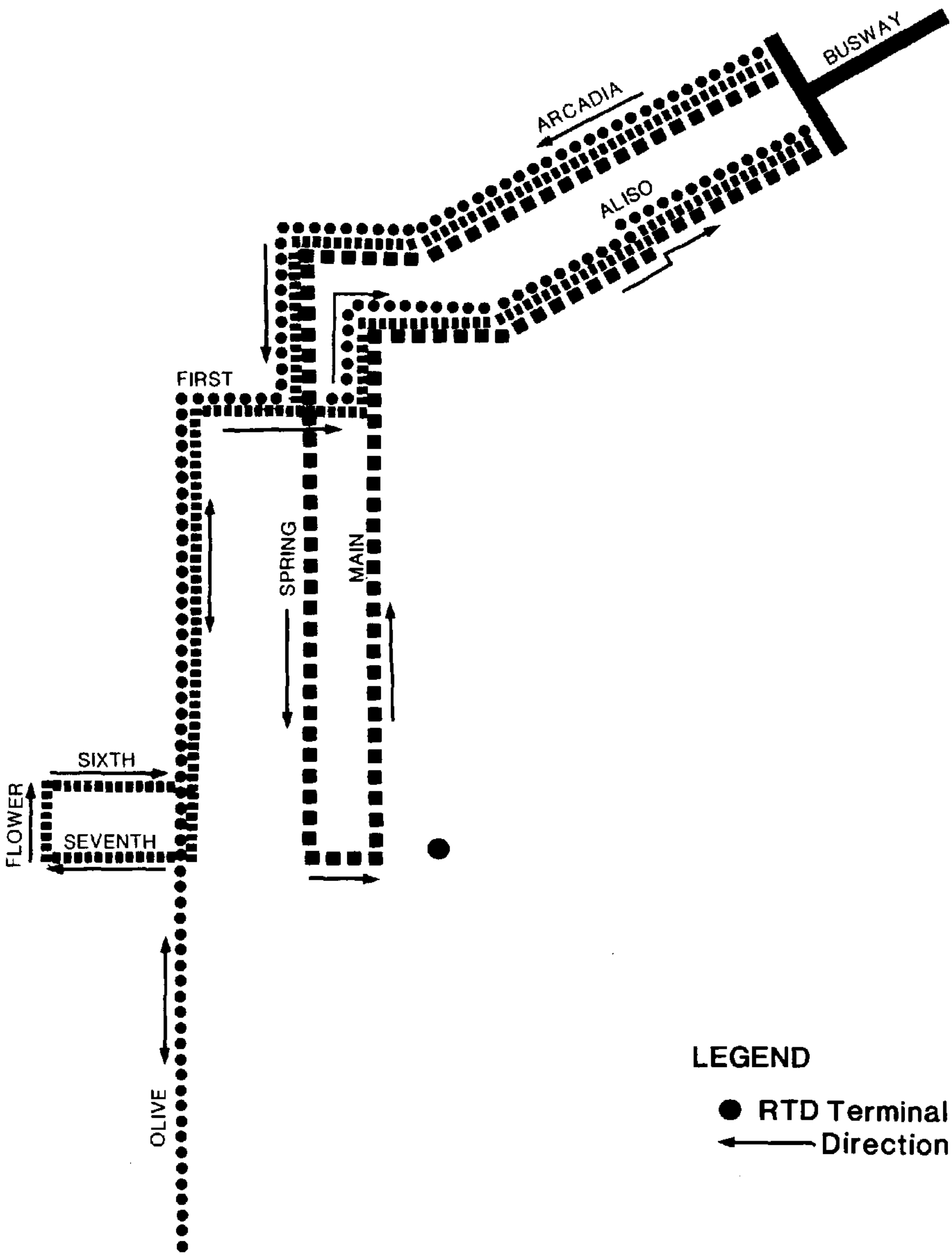

Figure IV-5 : ORIGINAL DOWNTOWN BUSWAY DISTRIBUTION SYSTEM the Santa Ana Freeway's access road, Aliso Street, and 1st Street, where their routes ran westward to Olive Street. Nine non-Busway interurban routes--Numbers 24, 52, 56, 63, 67-71--also used the one-way Spring/Main couplet prior to implementation. By having a contra-flow lane on Spring Street, all of these 15 Busway and non-Busway buses could be re-routed from Main to Spring for northbound movement.

The consultants projected the following impacts: "The contra-flow operation segments provide an increase in operational efficiency for the express buses and significant time savings for the transit passengers. Peak-hour operating speed, including stops, for contra-flow buses on the recommended route is estimated to average 14.5 miles per hour between the Santa Ana Freeway and the termination of the route on Fifth and Sixth Streets. This operating speed is 78 percent greater than the 8.0 miles per hour average estimated for conventional bus operation over the same route, and is comparable to the 14.5 to 15.0 miles per hour speed estimated for passenger automobile travel."[1]

B. Traffic Department Objections

These projections were challenged by the City of Los Angeles' Department of Traffic, which remained opposed to the contra-flow lane even after its implementation. The Department of Traffic's objections were: 1) that new signal timing, coming into effect in January 1974, would expedite with-flow movement, making Main Street a superior northbound route for buses; 2) that buses originating at the RTD Terminal (7th and Los Angeles Streets) going up Spring would be traveling farther by a more circuitous route and hence take longer to reach the Freeway; and 3) that simulated bus movement against the new southbound signal progression on Spring Street demonstrated that buses could not make good time on that route. In conclusion, the Traffic Department held "... that contra- flow on Spring Street involves increased distance, additional signals, and operations against signal progression ... (and) would take longer than operations 'with the flow' on Main Street, even considering the elimination of traffic induced delays and higher claimed bus running speeds for contra-flow."[2]

Traffic Department data was derived from their timed observations from 138 morning and 117 evening express peak period buses on Main Street, from floating car travel times, and from

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[1] P. 70, Wilbur Smith, 1973.
[2] P. 4, Research, Systems, and Safety Division, City of Los Angeles Traffic Department, Downtown Express Bus Study Report on Bus Line 60, Spring Street/Main Street, Staff Report Number 63.06, December 13, 1973, Los Angeles, California (hereafter, LADT, 1973).

traffic counts. The prevalent southbound signal progression would effect the proposed bus lane at 13 intersection signals and eight pedestrian mid-block signals.

The Traffic Department projected worsening traffic congestion on Spring Street southbound due to the loss of the easternmost (proposed contra-flow) lane effecting southbound and cross street buses (see Table IV-1). They also noted that the great majority of the delay experienced by buses on Main Street was attributable to stops for red lights and to pick up or discharge passengers, not to traffic congestion. These delays to express buses were found to constitute 89% (55% red lights and 34% passenger stops) of all time spent in delays on Main Street. Congestion in traffic lanes accounted for only 6% of delay time, while turning vehicles and blocked curb lane accounted for another 3% (see Figure IV-6). Express buses were delayed by all these causes for only a third of their Main Street route peak period travel time. The Traffic Department observed "....the rapidity with which the downtown area clears out after ....5:15 p.m., the traffic volume falls off very rapidly and congestion of any magnitude on the north-south streets is practically nil."[1] This suggested that the value of any exclusive bus lane was limited at best to little more than about one hour each weekday. The SCRTD proposal considered a constant contra-flow lane, 24 hours a day, seven days a week.

The Traffic Department's objections were disputed by the SCRTD. They had two principal concerns: 1) to move bus stops from Main Street (an unseemly Skid Row) to the more attractive Spring Street so as to provide a safer and more pleasant environment for bus riders; and 2) to provide some reserved lane for their Busway buses to reach the Santa Ana Freeway. While the usual degree of congestion may not be that bad, they felt an exclusive lane must be an improvement and would save them from intermittent heavy traffic delays, permitting them to operate closely to schedule. While buses from the RTD Terminal would have a more circuitous route northwards, only one of the six Busway routes came from the Terminal; all others ran on Olive Street.

Other objections to the contra-flow lane were from east side Spring Street businesses whose access for loading, unloading, and automobile standing would be eliminated, and from the Los Angeles Police Department, which estimated that the annual enforcement cost of the lane would be $314,000.[2]

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[1]P. 4, Ibid.
[2]Ray Hebert, "City Council Approves Contra-Flow Bus Lane," Los Angeles Times, February 6, 1974.

TABLE IV-I

Projected Change In Level of Service Resulting From Contra-Flow Operation On Spring Street

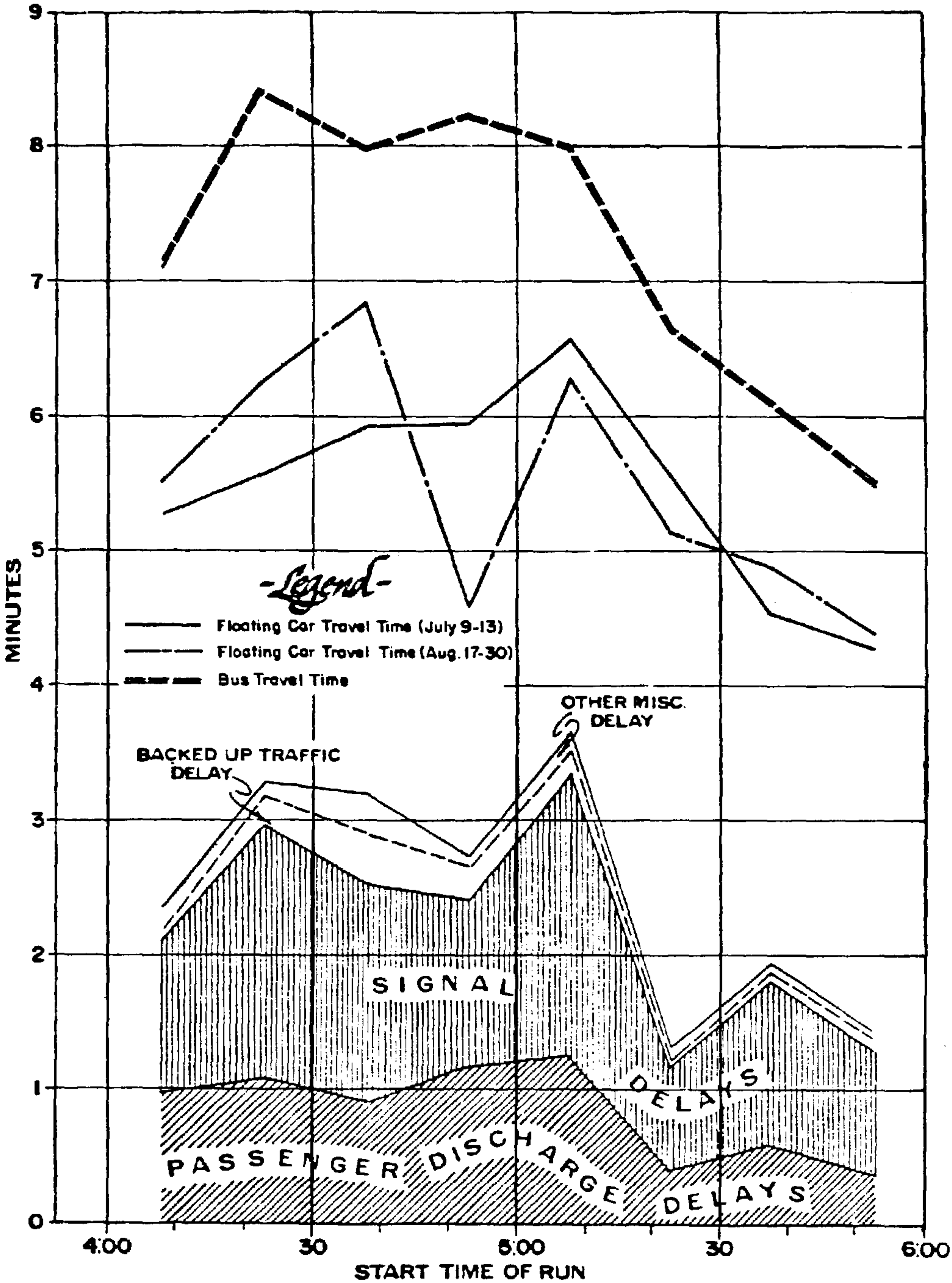
AM PEAK PERIOD 7:00 - 9:00
PM PEAK PERIOD 4:00 - 6:00

	Status		Capacity* (VPH)	Volume (VPH)	V/C	Level of Service
Spring & 8th	Normal	AM	1650	1020	.68	A
		PM	1450	1200	.83	A
	Contra-Flow	AM	1050	1020	.97	C
		PM	900	1200	1.33	E
Spring & 5th	Normal	AM	2650	2200	.83	A
		PM	2350	1650	.70	A
	Contra-Flow	AM	1650	2200	1.33	E
		PM	1450	1650	1.14	D
Spring & 1st	Normal	AM	2900	3000	1.04	C
		PM	2550	1600	.63	A
	Contra-Flow	AM	2400	3000	1.25	D
		PM	2100	1600	.76	A
Spring & Temple	Normal	AM	3150	2800	.89	B
		PM	3500	1400	.40	A
	Contra-Flow	AM	2200	2800	1.27	D
		PM	2450	1400	.57	A

*Based on Level of Service "C"

VPH = Vehicle Per Hour
V/C = Volume/Capacity Ratio

Source: Table C, Downtown Express Bus Study Report on Bus Line 60, Spring Street/Main Street, Los Angeles Traffic Department, Staff Report #6306, December 13, 1973.



TRAVEL TIMES AND BUS DELAY
MAIN STREET N/B
4:00-6:00 P.M

FIGURE IV -6

City of Los Angeles
DEPARTMENT OF TRAFFIC
S. S. Taylor, City Traffic Engr.

The Los Angeles City Council approved the Spring Street contra-flow lane against the objections of the Traffic Department, but on a provisional basis and with some important qualifications. The City Council, incorporating the Traffic Department's concerns into their ordinance, endorsed the experiment on February 5, 1974 "....to facilitate the expeditious movement of traffic...." Prior to adopting the ordinance, the Council approved a report stating: "...our main concern is to alleviate the problem of traffic congestion faced by commuters in the downtown area. The plan for a contra-flow bus lane on the east side of Spring Street to speed up buses bound for the El Monte Busway offers a solution to this problem."[1] This emphasis on speed was invoked by the Traffic Department in its subsequent criticisms of lane operation.

The lane opened on Sunday, May 19, 1974. Prior to implementation, the change was publicized and the new signs, markings, and parking restrictions set up. The 12' lane was divided from the rest of the roadway by a double yellow line and orange highway cones. An entrance to the south end of the lane for buses had to be across the unused paved space striped off from traffic at the Main-Spring Streets fork (see Photograph IV-1).

The way the contra-flow lane operation works is that inbound Busway buses from the San Bernardino Busway enter the Santa Ana Freeway as they approach downtown at Mission Road. They then exit the Freeway at Alameda Street and travel west on Arcadia to Spring Street, on which they run southbound with-flow (see Figures IV-2 & IV-7). Outbound (i.e., p.m. peak) buses travel contra-flow northbound on the eastern contra-flow lane of Spring Street until Aliso Street. There they turn east on Aliso to enter the Santa Ana Freeway at Alameda Street. Most Busway routes use Spring Street only north of First Street and travel on First Street between Spring and Olive Streets.

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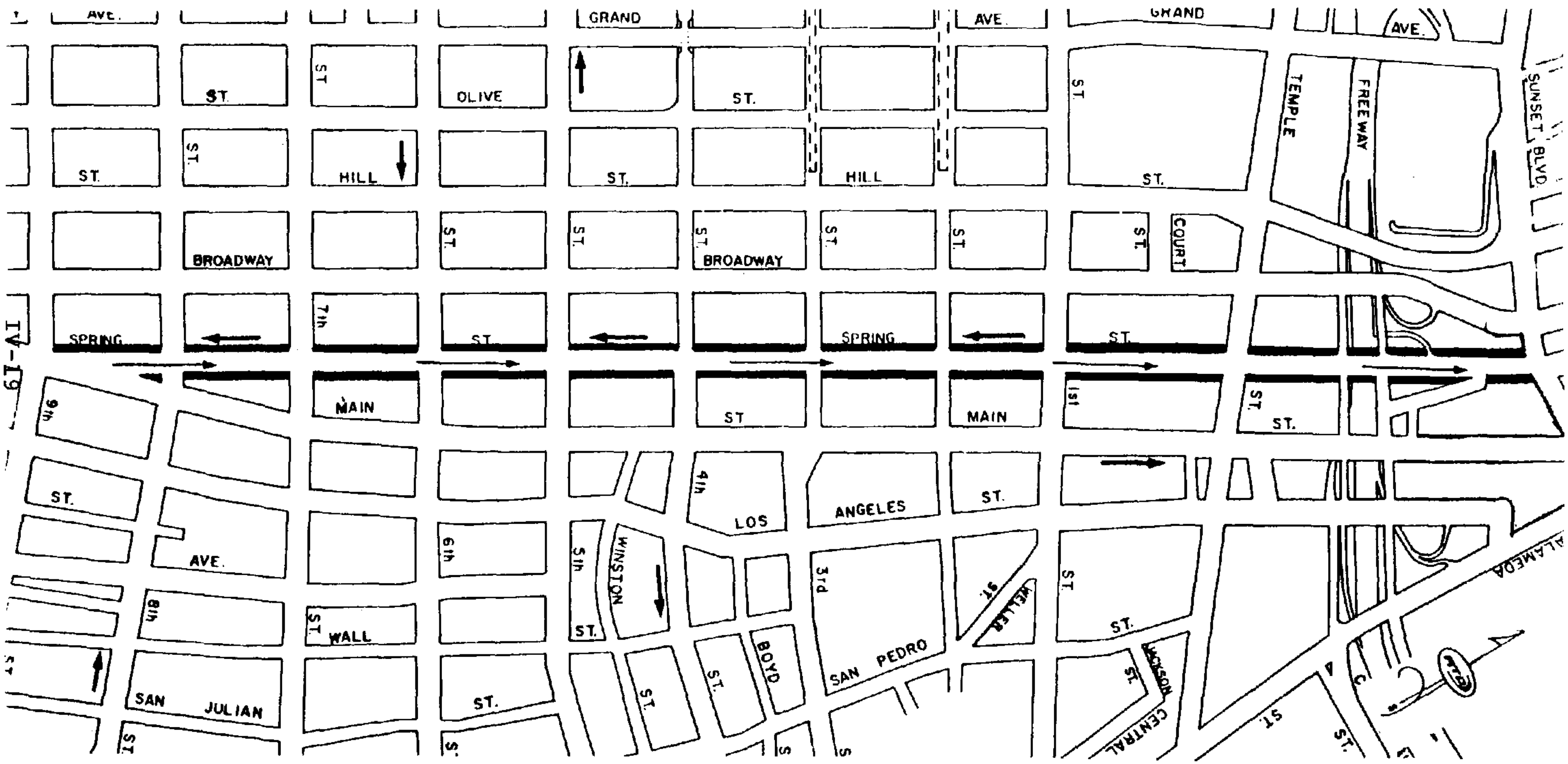
[1]LADT intradepartmental memorandum, S.E. Rowe to G.W. Skiles, 1/5/76.

Figure IV-7 : LOCATION OF SPRING STREET LANE



V. CONTRA-FLOW LANE PERFORMANCE

The City Department of Traffic (LADT) continued its criticism of the contra-flow lane after its implementation. Separate evaluations of the contra-flow operation by the LADT and by the Rapid Transit District (RTD) and its consultant differed markedly not only in their conclusions about the value of the lane, but also over the operational speed and delay data on which their conclusions were largely based.

The LATD and RTD evaluations are presented first separately in this chapter with some discussion, and then compared along with other evaluations. The commercial impact of the contra-flow operation is also discussed.

A. The Traffic Department Evaluation

In general the LADT's post-implementation analysis confirmed its earlier predictions: bus and automobile speeds were found to be lower, traffic congestion worse, the bus accident rate higher, and there was a slower and more circuitous route for some buses. The LADT found that the average contra-flow evening peak bus speed along Spring between 8th and Aliso Streets was 21% slower for the buses previously operating with-flow on Main Street (7.6 m.p.h. contra-flow, as opposed to 9.6 m.p.h. with-flow on Main Street).

Impact on Busway Buses

Among Busway Number 60 buses, speeds were 18.5% slower: 9.2 to 7.5 m.p.h. Number 60 buses were found to be traveling a CBD distance six-tenths of a mile (or 30%) longer under the contra-flow arrangement, and experienced a 55% increase in travel time (19.2 versus 12.4 minutes) on this downtown segment.[1] The longer route was due to the one-way street pattern and the inadequate turning radius at Spring and 7th (see Figure IV-8).

These results do not imply that all Number 60 passengers experienced the 55% longer downtown trip incurred by Number 60 buses. Only 53% of Number 60 outbound riders boarded at the Terminal, the balance (47%) boarded further north on Spring Street, between 8th and 1st Streets. This latter group of riders experienced a delay of only 1.5 minutes or less, compared to the former Main Street route.[2] Furthermore, the Number 60 was only one of nine Busway lines then in operation.

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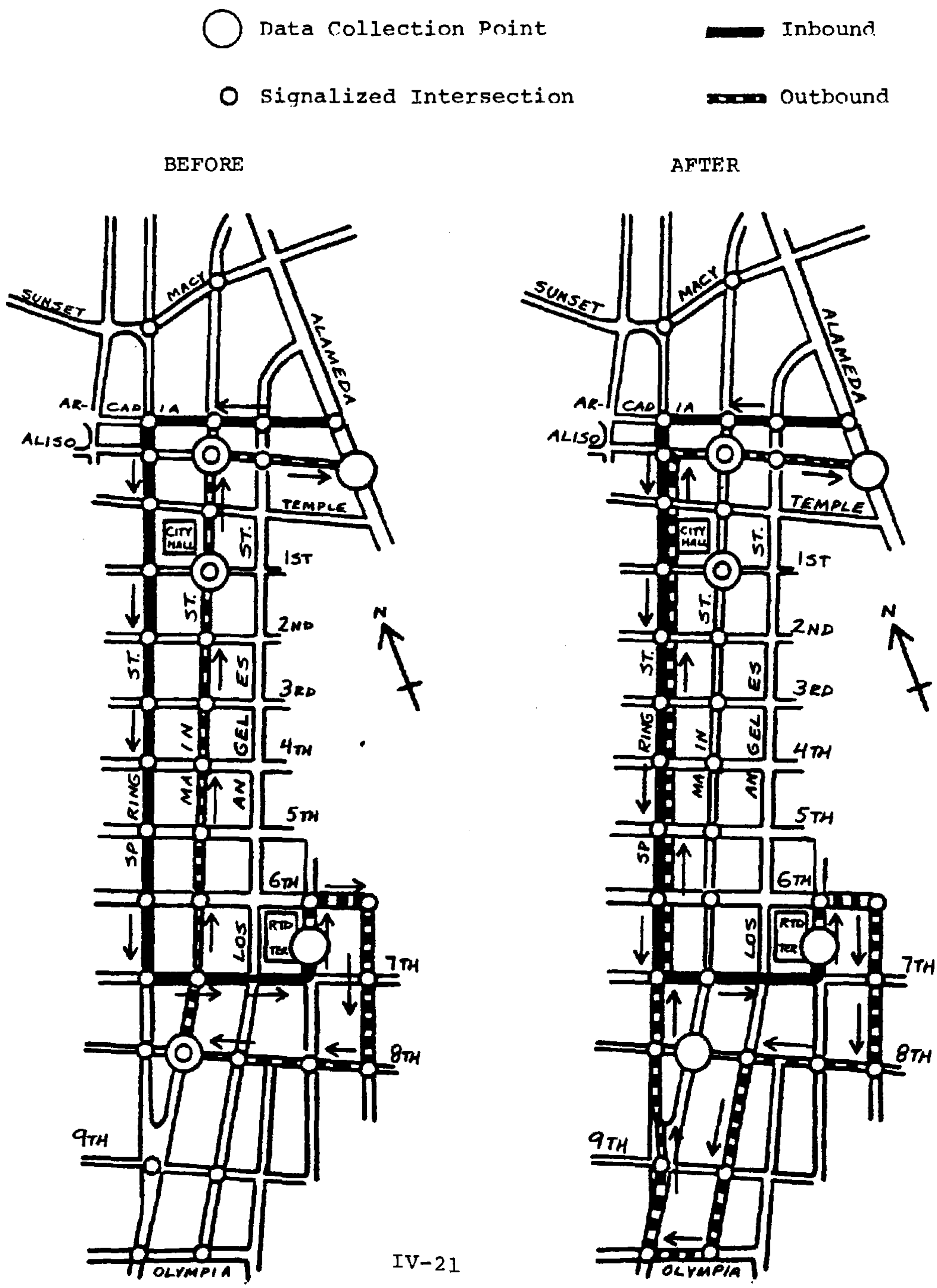
[1] P. 3, Department of Traffic, City of Los Angeles, Spring Street Contra-Flow Bus Lane Operational Evaluation Study, August 28, 1974; Los Angeles, California (hereafter: LADT, 1974).
[2] Pp. 22 and 31, Ibid.

Figure IV-8: BUSWAY ROUTE NUMBER 60 DOWNTOWN ROUTE BEFORE AND AFTER SPRING STREET CONTRA FLOW LANE



Six other lines (Numbers 401-405, and 53F) traveled on Olive Street for most of their downtown run, entering the Spring Street contra-flow lane only for the two-block segment between 1st and Aliso (see Figure IV-9). Two other Busway routes (52F & 63F) traveled the entire distance of the contra-flow lane as did the Number 60 but as they did not go to the RTD Terminal their increase in delay was less. The LADT found no measurable delay on these six routes, which were traveling the same distance. Their travel time on the two-block portion of the contra-flow lane (north of 1st Street) was 2.0 minutes, which is the same as the two-block with-flow time on Main Street north of 1st.[1]

Impact on Traffic

The LADT found that southbound through traffic speeds on Spring Street were reduced 19% in the morning peak period (7:00-8:30 a.m.) from 19.4 m.p.h. to 15.7 m.p.h. In the evening peak period (4:00-5:30 p.m.), this reduction was from 19.8 m.p.h. to 15.9 m.p.h. Prior to the January 1974 resignalization, speeds had averaged 13 m.p.h.[2] On Main Street, from which many of the contra-flow buses had been removed, traffic speeds rose slightly.[3] Traffic counts, taken in June 1974, on northbound Main Street indicated an 18% morning and 10% evening decrease in traffic from the summer of 1973. A 6% decrease in southbound Spring Street traffic volume was also noted.[4]

Impact on Southbound Buses

Southbound Busway and non-Busway buses were found to be moving slightly slower after implementation of the contra-flow lane. The LADT attributed this to the 19 percent loss in traffic speed caused by the loss of one southbound lane. Morning southbound peak period speed between 1st and 7th Streets--where only one of the seven Busway routes ran--was reduced from 11.3 m.p.h. to 10.2 m.p.h. (-9.6%) while afternoon peak period speed fell from 10.2 m.p.h. to 8.5 m.p.h. (-17.2).[5]

The LADT's summary observations and conclusions were: 1) "...bus travel times through the downtown Los Angeles CBD for routes incorporating the contra-flow lane were 27 to 55% longer

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[1]LATD, 1974, p. 22.

[2]Research and Systems Division, Department of Traffic, City of Los Angeles, Accident Analysis, Contra-Flow Lane Experiment, Staff Report Number 70.04, September 30, 1975 (hereafter: LADT, 1975).

[3]Ibid., pp. 3, 28-29, 34-35.

[4]LADT, 1974, pp. 28-29, 34-35.

[5]Ibid., pp. 21-23, 29.

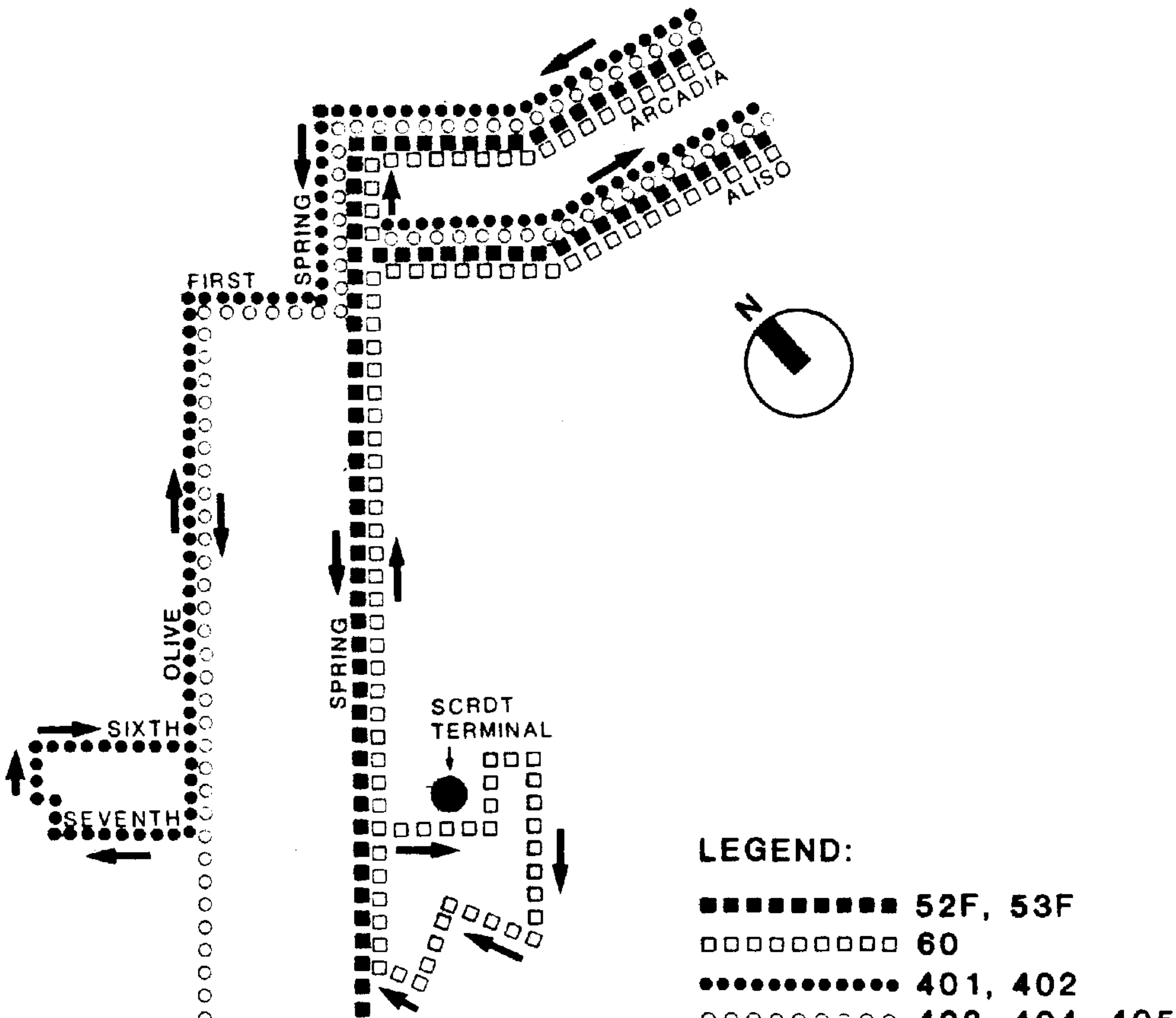

Figure IV-9: DOWNTOWN CIRCULATION OF BUSWAY LINES AFTER IMPLEMENTATION OF CONTRA-FLOW LANE, 1974

than previous routes via Main Street...."[1] 2) curbside delivery and pick-up of goods and people was prohibited, hampering commercial activities; 3) underground maintenance suffered; 4) "Delays due to signal stops, bus platooning, and lengthy passenger loading operations appeared to be cumulatively greater than similar delays experienced on former Main Street routes"; 5) a major defect of the 12'-wide contra-flow lane operation compared to former with-flow use of Main Street was the abandonment of Main Street skip-stopping and segregation of bus stops on alternating blocks between local and Busway routes; 6) the computer simulation of contra-flow operations, done in 1973 by the Department of Traffic, had been accurate in its predictions of route speeds and travel times of the proposed Spring Street contra-flow lane. The LADT's recommendation was to end the Spring Street contra-flow lane and return the buses to Main Street.[2]

Accident Analysis

The LADT accident analysis found a substantial increase in bus accidents on the effected portion of Spring Street from an average of 4.3 in the three 42-week periods prior to implementation of the contra-flow lane to 17 in the 42-week period subsequent to contra-flow operation. This increase was twice the increase in the number of buses operating on Spring Street. Personal injuries grew from an average of two in the previous 42-week periods, to 17 (7 of them in the contra-flow lane) in the period after implementation (a 750% increase). Bus involvement in pedestrian accidents increased from an average of 0.67 in the three 42-week periods prior to implementation, to 6.0 in the 42 weeks after implementation; five of these accidents occurred in the contraflow lane. Total traffic accidents on Spring Street have remained constant at 75 per year while traffic has decreased slightly.[3]

While this experience is hardly encouraging, its statistical significance is not clear. The LADT also found a tripling of bus-related accidents on Main Street, after half its buses had been shifted to the Spring Street contra-flow lane--six times the number of accidents per bus run.[4]

The LADT cited the experience of other cities to substantiate its conclusion that exclusive bus lanes only result in significant bus travel time savings where traffic congestion is severe and that the establishment of contra-flow lanes may even lower bus operating speeds by having them run against the signal progressions without providing passing ability. The

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[1]Ibid, p. 34.
[2]Ibid., pp. 34-36.
[3]LADT, 1975.
[4]Ibid.

unsuccessful Louisville, Kentucky experiment with contra-flow bus lanes was cited in the LADT report because of its similarity to Number 60's problem on Spring Street: "...extensive detours incurred in traveling from the CBD to the exclusive outbound bus lane... The bus, so to speak, had to go out of its way to utilize the PM exclusive bus lane and the resulting route deviation was very time consuming....the buses actually saved time using with-flow facilities."[1]

B. The Rapid Transit District Evaluation

Contra-Flow Bus Speeds

Unlike the City Traffic Department, the SCRTD regarded the contra-flow lane's performance positively and wanted it to continue. Preliminary RTD data indicated that the average bus speed in the contra-flow lane was 8.6 m.p.h., an improvement over the 7.3 m.p.h. they estimated for the northbound buses previously using Main Street.[2] The LADT had given these speeds as 7.6 m.p.h. and 9.6 m.p.h., respectively. These different estimates are shown below:

	LADT	RTD
Main Street N/B	9.6 m.p.h.	7.3 m.p.h.
Spring Street C/F	7.6 m.p.h.	8.6 m.p.h.

While the separate calculations for contra-flow speeds were only 1 m.p.h. apart, there was wide disparity for the former Main Street speeds--7.3 (RTD) versus 9.6 (LADT). After an examination of the RTD figures by the LADT and discussions on data differences, the RTD revised its figures.

The LADT had felt that the RTD figures were not accurate for the "before" condition on Main Street, because they were based on local bus speeds as of 1972 (before the Janaury 1974 resignalization scheme, which raised speeds). Instead they should have been estimated during express bus operations on Main Street which began shortly before the contra-flow lane implementation on the street (the LADT method). Also, LADT felt they had done a more thorough analysis as they had used exact distance measurements from city engineering maps and clocked bus times to the nearest second, using synchronized stop watches at four checkpoints. The methodology employed by the LADT for measuring southbound bus speeds involved the same

[1]R.H. Pratt Associates, Results of Case Studies and Analysis of Busway Applications in the United States, Volume II, January 1973, as quoted in LADT, 1974.

[2]Pp. 1-3, and Addendum Number 2, Southern California Rapid Transit District, Report on Spring Street Contra-Flow Lane, July 1, 1974, Los Angeles, California (hereafter, SCRTD, 1974).

checkpoint observations and used synchronized stop watches. For determination of the "before" Main Street speeds, individual buses of the routes to be re-routed up Spring Street were followed by City vehicles and their passage time at each intersection noted. The methodology of the LADT enabled them to get data for different segments of the contra-flow lane and for different bus routes.[1]

The final RTD analysis found that evening peak (4-6 p.m.) bus speeds on the contra-flow lane were 8.8 m.p.h., or .8 m.p.h. slower than the LADT figure for "before" Main Street northbound. The RTD also found its morning peak (7-9 a.m.) buses running slower on the Spring Street contra-flow lane (10.5 m.p.h.) than they had on northbound Main Street (13.0 m.p.h.).[2] These figures do not reflect the greater increase in operating time on Line #60 caused by its uniquely circuitous route after contra-flow.

While conceding that bus operating speeds on the contra-flow lane were slower than under the previous with-flow arrangement, the RTD's consultant felt that "...it is impractical to compare operating speeds on Main and Spring Streets." This, he said, was because: 1) with the Busway ridership increase from 6,000 daily riders (January 1974) to 14,000 (May 1975), passenger loading and discharging times as well as the number of buses had increased on Spring Street and this was given as "...the principal contributor to the difference between bus speeds on Main and Spring contra-flow..."; and 2) they felt a valid speed comparison could not be made of a single contra-flow lane with a multi-lane one-way street on which buses could pass each other. The RTD consultant calculated that "...when the speeds are adjusted for the given passenger loads and lane density of buses, the Spring Street contra-flow lane is presently operating approximately 1.0 m.p.h. faster than the Main Street lane..."[3]

The RTD also found that its riders <u>perceived</u> the contra-flow lane as faster. From a survey of 1,463 contra-flow lane bus riders taken on June 10, 1974, a few weeks after implementation, it was found that 93% of the respondents had been riders before implementation. Only 11.3% perceived the contra-flow operation as slower, 56.2% thought it was faster. While 15.3% found major delays more frequent, 46.3% found them less

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[1]LADT, 1974, pp. 14-16; and project notes, Gardner Thomas, LADT.

[2]Wilbur Smith Associates, <u>Evaluation of Spring Street Contra-Flow Lane</u>, for the Southern California Rapid Transit District, 1975, Los Angeles, California, p. 42 (hereafter: Wilbur Smith, 1975).

[3]Wilbur Smith, 1975, pp. 43 and 56.

frequent.[1] The respondents represented a tenth of contra-flow bus riders.

Impact on Traffic

The final RTD analysis largely concurred with LADT figures. They found a "before" to "after" speed reduction on Spring Street from 19.4 m.p.h. to 15.4 m.p.h. (7-9 a.m.), a drop in level of service from C to D, and a drop from 19.8 m.p.h. to 17.5 m.p.h. (4-6 p.m.), a drop from C to the C-D boundary. Traffic speeds also were found to have fallen on Main Street in the morning from 22.8 m.p.h. to 20.9 m.p.h. (7-9 a.m.) but rose slightly in the evening from 17.2 m.p.h. to 18.5 m.p.h. (4-6 p.m.).[2]

Impact on southbound buses was negligible. The RTD analysis found that morning peak southbound bus speeds on Spring increased by 0.7 m.p.h. (7%) while evening peak speeds stayed the same at 9.3 m.p.h.[3]

Accident Analysis

The RTD accident analysis corroborated the LADT's finding of a significant increase in bus-related accidents in the contra-flow operation, more than twice the increase in bus mileage on the lane. They found 13.2 bus-related accidents per million bus miles on Spring Street southbound, and 11.2 per million bus miles on Main Street northbound, before implementation of the contra-flow lane. After implementation they found bus-related accidents per million bus miles on Spring Street rose to 29.6.[4]

However, the RTD study also noted the curious and much greater increase of bus-related accidents on Main Street from 11.2 per million bus miles to 49.3. This increase came after half the buses had been removed from Main Street and with no change in the with-flow operation there. The much greater increase in bus-related accidents on Main Street in the same period, recorded by both the LADT and the RTD's consultant, throw considerable doubt on the meaning of Spring Street's increase in bus-related accidents. Also only a handful of incidents and persons were involved in these accidents (there were only 1.6 bus accidents per month on Spring Street after implementation).[5] The fact that bus accidents increased more on Main Street suggests that the contra-flow operation cannot

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[1]Ibid., pp. 34-35.
[2]Ibid., pgs. 27-28, 43-45.
[3]Ibid., p. 42.
[4]Ibid., 1975, p. 46.
[5]Ibid., 197, p. 46.

be held as more dangerous than the with-flow operation it replaced.

The RTD analysis also compared the bus accident rate on Spring Street favorably with a national average city bus accident rate of 67 per million bus miles, and with contra-flow bus lanes in Madison, Wisconsin (205.0 accidents per million bus miles), Seattle (334.0), Indianapolis (69.0), and Louisville, Kentucky (67.0). They also felt that in time, with greater awareness of contra-flow operation, the accident rate would decrease.[1]

Ridership Increases and apparent ridership satisfaction with the lane operation were cited by the RTD as indicators of the success of contra-flow operations, though they make no claims as to what small share of the ridership increase is due to the contra-flow operation as so many other factors are involved. 71.7% of the surveyed bus riders thought the new bus stop locations on the east side of Spring Street were more convenient than former bus stops on Main Street. Only 10.3% found them less convenient.[2] This corroborates with all other indications of the westward trend of downtown employment and suggests that by moving the bus route one block to the west they were bringing the service closer to the market.

Ridership increased from 10,000 to 15,000 daily riders in the year after implementation.[3] However, many factors were responsible for this and the contra-flow lane, if it had any effect on ridership, was a very small influence. The major reasons for the ridership increase were awareness of the Busway's performance and the gasoline price rise.

C. Economic and Neighborhood Impact

Besides the issues of bus speed and traffic congestion raised by the LADT, some businesses along the lane on Spring Street voiced complaints over access problems. These complaints came from a business community very much in decline.

Prior to the Second World War and the subsequent Southern California suburban boom, downtown Los Angeles was a much more important place than it is today. It was then the commercial center of Southern California; it had all the tall buildings and was the center of a massive interurban and municipal light rail system, the Pacific Electric's Red Cars. Back then, Main Street was Main Street and not a Skid Row of pornographic movies and winos, and Spring Street was the financial capital of the Southwest.

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[1] Ibid., 1975, pp. 46-47.
[2] Ibid., 1975,p. 35.
[3] Ibid., 1975, p. 43.

Spring Street is still lined with historic bank and office buildings and once-fashionable hotels but the post-war westward expansion of downtown has enervated Spring Street. By the early '70s the financial community had largely moved to the West Side and the commercial vacancy rate on Spring Street was up to 80% according to one local source. Many buildings had been torn down to make way for open air parking lots which comprised a large part of every block on the east side of Spring Street from 2nd to 10th Streets. The 1972 Central City Los Angeles Development Plan 1972-1990 commented on Spring Street: "Downtown's historic business street was losing renters to west side expansion and was threatened from the east (Main Street) by progressive blight."

The loss of curbside access for loading and delivery would have been a significant problem for Spring Street commerce in its heyday. By 1974 objections from the El Dorado Hotel, which lost its only loading zone, from banks, whose armored car deliveries had to be made across the bus lane, and from smaller establishments, carried little weight. The "loss of business to financial institutions" that the Union Federal Savings and Loan Association attributed to the "No Stopping at Any Time" contra-flow lane[1] had already been a fact of life on Spring Street.

The Central City Association (CCA), an influential federation of downtown business interests that strongly favors improved mass transit, tentatively supported the bus lane on an experimental basis but wanted the City Traffic Department to evaluate the project after implementation. Heeding the objections of some businesses, the Traffic Department, and the local councilman, the CCA called for an end to the contra-flow lane in December 1974, citing "problems for business and property owners which ...outweighed benefits--if any."[2]

The City Council did not consider ending the lane despite Traffic Department and CCA objections. It is questionable how much of an added problem the loss of the curb was to this declining commercial street. An SCRTD survey of 41 businessmen on the east side of Spring subsequent to contra-flow operation found 13, less than a third, claiming the lane was "disadvantageous" to their business and created major loading and unloading problems for them."[3] Even the Los Angeles Times, whose

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[1]William McPhillips, "Spring Street Merchants Upset at Contra-Flow," Los Angeles Times, 6/14/74; and meeting notes, Gardner Thomas, LADT.

[2]Testimony of Earl Clark, CCA President and Daniel C. Waters, CCA General Manager, before Los Angeles City Council ad hoc Committee on Rapid Transit, as reported in: "LA Businessmen Urge Halt to Contraflow Bus Experiment," Los Angeles Times.

[3]Wilbur Smith Associates, 1975, p. 38.

reporter had found Spring Street merchants "without exception" opposed to the lane in June, editorialized in favor of continuing the lane, with reservations, in December.[1]

D. Evaluation, Comparisons and Conclusions

This section contains a brief evaluation of the contra-flow lane 1974-79. An overall evaluation after the 1979 changes to the lane, is contained in Section VIII of this Chapter.

Bus Operational Speed. Whether the contra-flow lane actually facilitated or hampered bus movement in and out of the CBD was the major issue in the planning and post-implementation analysis of the lane by the Los Angeles Traffic Department, the Rapid Transit District and its consultants, and others. All studies by the LADT and four consultants found operational bus speeds on the Spring Street contra-flow lane to be slower than bus speeds on Main Street.

The consultant for SCAG found that an extra 1.2 minutes in the morning peak, and an extra 1.7 minutes in the evening peak had been added between 1st and 6th Streets to the travel times of Main Street buses which had been re-routed onto the Spring Street contra-flow lane. The consultant concluded that: "... contra-flow lanes in themselves do not save travel time if they are constructed without preferential traffic signaling...it appears that the contra-flow lane has not solved the basic problem of speeding downtown passenger distribution consistent with the greatly increased speed of the Busway."[2]

It can be concluded that buses did not move faster with the contra-flow lane. However, the lane may have provided advantages not credited by the LADT, which was "...concerned only with the question of whether or not commuters are being moved more quickly through the Central Business District (CBD)."[3] The advantages had to do with better marketing--better delivery of the service to the market. The lane provided: 1) possibly better schedule reliability; 2) a constant visual reminder of the bus route and RTD system; 3) the relocation of riders to bus stops in a more acceptable environment away from Skid Row--a factor which influenced commuters' attitudes about waiting for the bus; and 4) bus service "... one block closer than the route previously used to most P.M. trip origins..." so that "... the total time from office to

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[1]William McPhillips, "Spring Street Merchants Upset at Contra-Flow," Los Angeles Times, 6/14/74; and 12/13/74 Editorial, Los Angeles Times.

[2]Pp. 127-128, Crain, 1975. The other consultants were Sperry Rand and Thomas Montgomery.

[3]LADT, 1974, p. 14.

departure from the CBD probably is not increased."[1] The 1,463 bus riders surveyed found Spring Street more convenient than Main Street by 71.7% to 10.3%[2] The lower walking time combined with shorter headways due to increased service probably cancelled out the slight loss in bus operating speed.

Traffic and Parking Impact. The LADT and RTD studies both established that on Spring Street the southbound traffic level of service declined, but still compared favorably with other downtown streets. The peak traffic crunch is also short; after 5:15 p.m. the downtown area clears out considerably.

While every block on the east side of Spring Street between 2nd and 10th Streets has an off-street parking lot and most have exits onto Spring Street, these lots have alternative access to cross streets and, in some cases, to Main Street. Vehicles can cross the bus lane perpendicularly from these lots. 389 Spring Street drivers responded to a roadside, mail-in questionnaire distributed by the RTD on June 9, 1975. Of these, 65.8% said they did not have any difficulties entering or exiting off-street parking facilities because of the contra-flow lane. Only 17.0% did. Over 83% of the responding drivers drove twice or more every week on Spring: 72.5% drove there daily. Eighty percent of the drivers also thought lane signing was adequate, 76% said they hadn't noticed any increased congestion on Spring Street, and 78% found it no "more undesirable" to drive on Spring Street than other downtown streets.[3]

Modal Shift. According to the comprehensive cordon counts conducted by the Los Angeles Department of Transportation (formerly Department of Traffic), the proportion of passengers (all vehicular modes) entering the CBD by bus at the cordon line declined slightly from May 1974 (when the contra-flow lane was implemented), to May 1978. Transit ridership data for these cordon counts was provided by the SCRTD and other bus operators; vehicle counts were made by machine. The bus share declined from 28.9% to 27.7% while the automobile share rose from 65.7% to 66.8% (see Figure IV-10). The 27.7% 1978 transit share was still an increase over the 24.2% 1972 transit share, however, heavy subsidization and the institution of a flat fare had occurred in the intervening six years. Transit's share of the market had been higher in 1957 (33%). Even then it had been in decline from its previous shares in 1941 (39%) and 1924 (61%) back in the Pacific Electric streetcar days. Interestingly, the total number of persons entering and leaving the downtown at the cordon line was slightly less in the 1970s than

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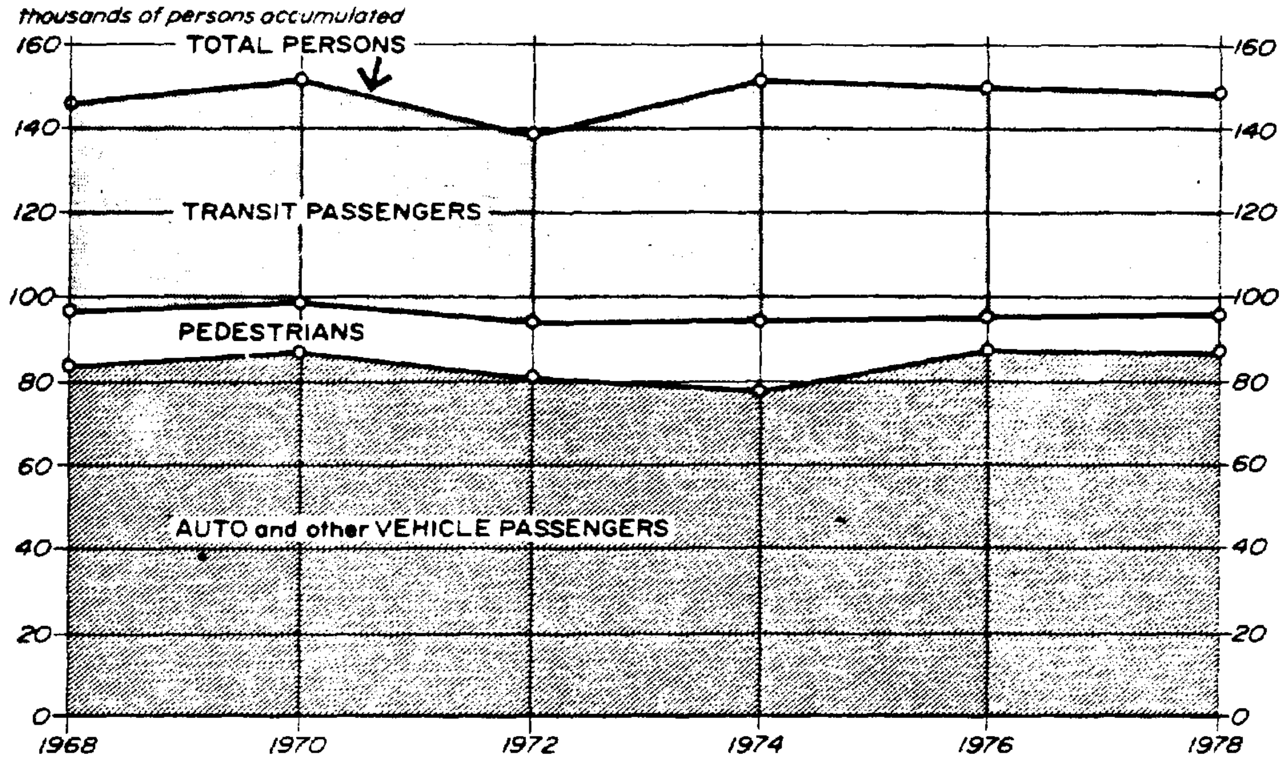
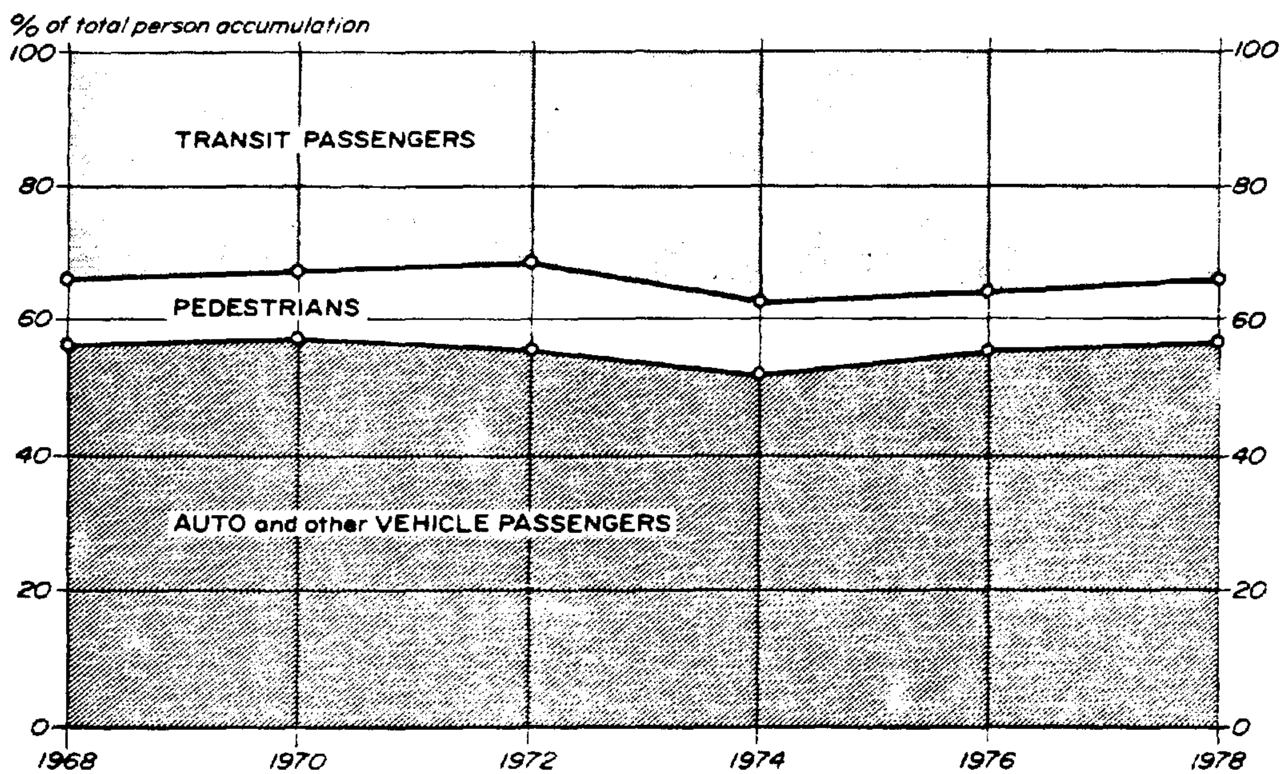
[1]Crain, 1975, p. 127.
[2]Wilbur Smith, 1975, p. 35.
[3]Ibid., p. 32.

From Plate 12, LADOT 1978 CBD Cordon Count



PEAK PERIOD PERSON ACCUMULATION
VOLUME BY MODE



PEAK PERIOD PERSON DISTRIBUTION
PROPORTION BY MODE

TREND IN PEAK PERIOD PERSON ACCUMULATION **Figure IV-10**

it was in 1924 or 1941, reflecting job and population trends in Los Angeles, where growth had occurred only in the suburbs.[1]

Economic and Social Impact. The institution of the contra-flow lane created obvious problems for any commercial enterprise on the east side of Spring Street. Statements were made to the effect that the lane had a deleterious economic impact and it might be inferred that the contra-flow lane was partially responsible for Spring Street's decline. The local view is that "progressive blight" from the east is certainly more in evidence on Spring Street today than in 1974. One transportation official noted that a major reason for having buses use the contra-flow lane on Spring Street was that: "...the RTD wanted to have its riders wait for the bus on Spring Street, which was a much nicer street--only it's not so nice now."

According to business leaders, whatever negative impact the contra-flow lane had an commerce was negligible because it effected only a few small establishments. And any negative. impact would also have to be traded off against the better transit marketing provided by the lane. Today the transit system is considered of prime importance to Los Angeles CBD commercial vitality by downtown business leaders and community planners.

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[1]LADT, Cordon Count, Downtown Los Angeles, May 1974, Los Angeles, California and LADOT, Downtown Los Angeles, Cordon Count, May 1978, Los Angeles, California.

VI. CONTRA-FLOW MODIFICATIONS (1979)

A. Summary

The Spring Street contra-flow lane, as originally implemented in 1974, had proven over the years to have a number of operational shortcomings. First, being only 12-13' wide, any bus stopping--whether to pick up or discharge passengers, make a turn, or disabled mechanically--would halt all buses behind it; they could not pass. Secondly, with buses of 29 different bus routes all stopping in platoons along the same curbside strips in irregular order between First and Aliso Streets, there resulted confusion and turmoil among the crowds of waiting passengers there.[1]

In 1978 the Los Angeles Department of Transportation (LADOT) was formed out of the Department of Traffic and other City agencies. Part of the reason for creating the LADOT was to coordinate multi-modal transportation and apply traffic measures favorable to transit. The LADOT and the SCRTD cooperated to study the contra-flow lane's problems and came up with a number of modifications to the lane north of First Street. These were implemented on November 19, 1979.

The modifications, intended to speed bus movement and reduce the problems for waiting passengers, were: 1) doubling the width of the contra-flow lane between First Street and Macy Street/Sunset Boulevard to allow bus passing on this segment with the highest bus volume; 2) alternating Busway and non-Busway bus stops on the First Street to Arcadia Street segment to permit bus skip-stop operations and to reduce passenger confusion; and 3) the conversion of Spring Street's northward extension (New High Street) from one-way southbound, to two-way operation to allow a contra-flow continuum for Spring Street buses (see Figures IV-11, IV-12, IV-13 and IV-14).

B. Identification of Problems

Bus Delays. Bus passing could not occur in the single 13' lane and the frequent bus stops and opposing signalization resulted in frequent and long queues of buses running on the contra-flow lane. This problem was at its worst when a bus broke down in the lane, corking the "bus bottleneck." This problem did not occur often and when it did a mechanic could usually get the

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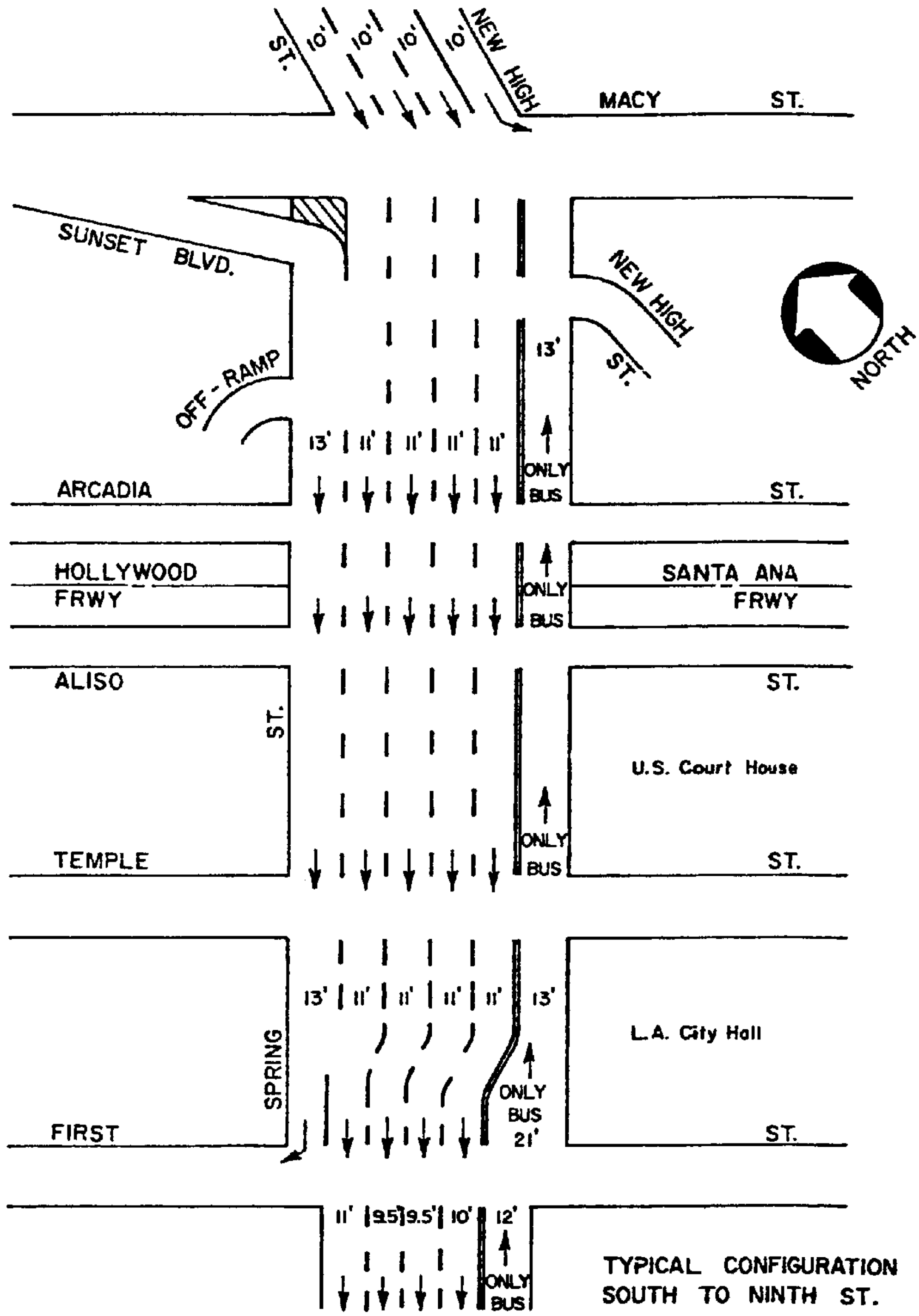
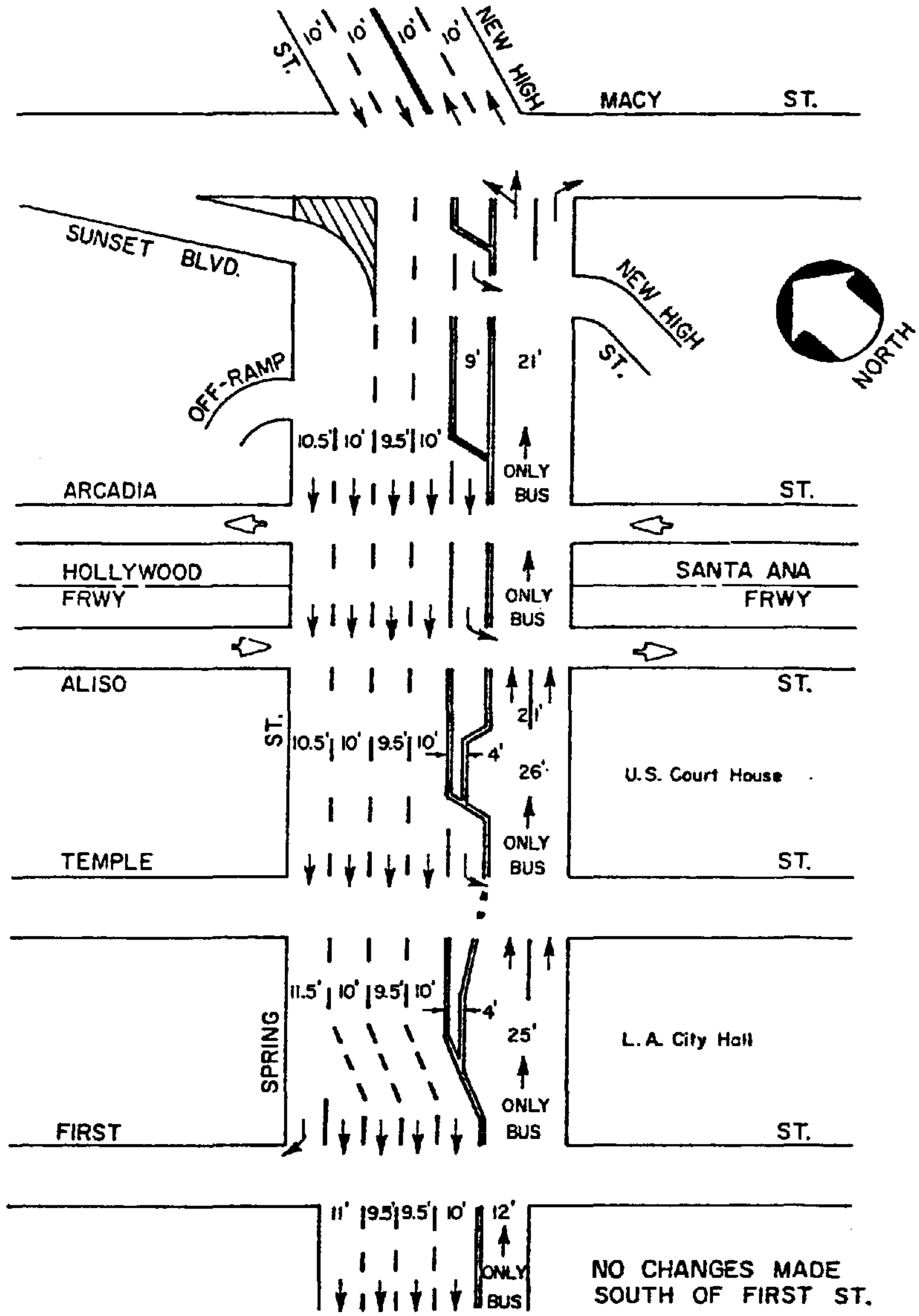
[1]Transportation Engineering Division, Los Angeles Dept. of Transportation, and Surface Planing Dept., Southern California Rapid Transit District, Evaluation of the Spring Street Contra-Flow Bus Lane Widening and Re-routing of Buses on New High Street, A Short-Range Transit TSM Study, for Southern California Association of Governments, Dec. 1980, Los Angeles, California (hereafter: LADOT & SCRTD, 1980).



ORIGINAL SPRING ST.
CONTRA-FLOW BUS LANE
CONFIGURATION

FIGURE IV-11

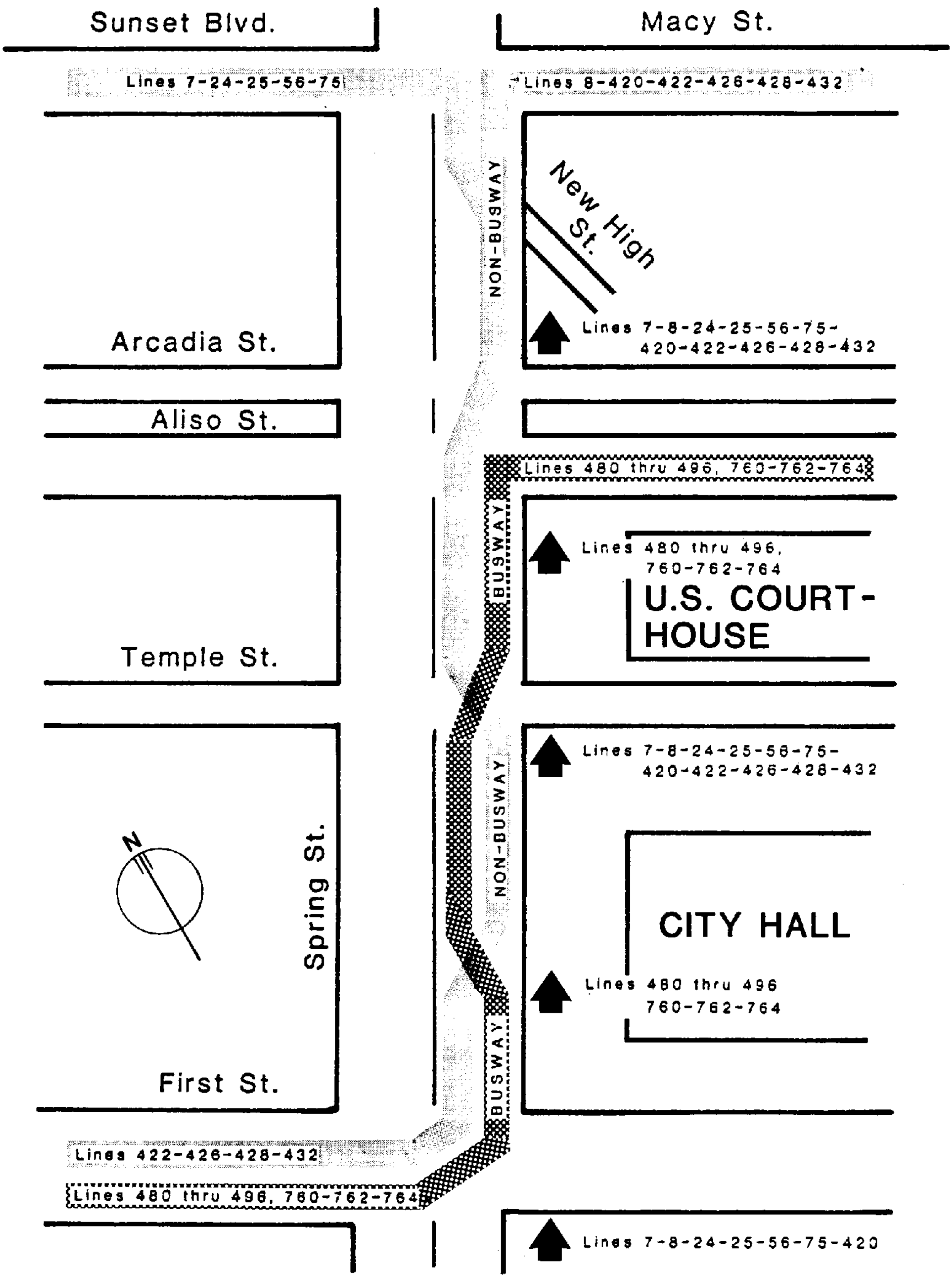
From <u>Evaluation of the Spring Street Contra-Flow Bus Lane Widening and Re-routing of Buses on New High Street</u>
LADOT and SCRTD, December, 1980.



REVISED SPRING ST. CONTRA-FLOW BUS LANE CONFIGURATION

FIGURE IV-12

From Evaluation of the Spring Street Contra-Flow Bus Lane Widening and Re-routing of Buses on New High Street LADOT and SCRTD, December, 1980.



SPRING STREET CONTRA-FLOW BY-PASS OPERATION

SOURCE: Southern California Rapid Transit District

FIGURE IV-13

disabled bus started in short order. When a mechanic could not accomplish this, a time-consuming detour, directed by a RTD field supervisor, using a tow truck in rush hour traffic was the common solution to that problem. When Busway buses were occasionally delayed by 5-10 minute traffic backups on the Santa Ana Freeway (their link to the San Bernardino Freeway Busway), this resulted in backing up all buses in the contra-flow lane.[1]

The problem was worst on the two-block stretch which had the highest volume of buses--Spring Street between First and Aliso Street where 29 bus routes ran--260 buses between 4-6 p.m.[2] The 1974 4-6 p.m. volume on the same stretch had only been about 150 buses.[3] The increase in bus volume on this two-block stretch in the Civic Center was due to an increase in Olive Street Busway service from six routes in 1974 (#53F, 402-405) to 14 routes by 1979 (#480, 482-494), additional Flower Street Busway service (760 762, 764) and four non-Busway Olive Street interurbans (#422, 426, 428, 432). These Olive Street routes used the contra-flow lane from First to Aliso Streets before heading east on Aliso to the Freeway.

Service on the southern eight-block portion of the lane had declined since 1974, reflecting the westward shift of the CBD. In 1974 three Busway (#52F, 60, 63F) and nine non-Busway (#24, 52, 56, 63, 67-71) routes used the southern portion of the lane as well as the First-Aliso segment; this became reduced to two Busway routes, #496 (the old #60) and 495, and seven non-Busway routes--#7, 8, 24, 25, 56, 75, and 420--or an overall reduction in the number of daily bus runs on the lane from 1,300 in 1974[4] to 1,145 in 1980.[5].

The increase in service frequency on routes using only the First-Aliso two-block portion and the corresponding decrease in service on routes running the length of the lane created an imbalance in bus volumes on the contra-flow lane in the peak period with about double the number of buses operating north of First Street that operated south of First. The result was a congested "bus bottleneck" between First and Aliso--a section with heavily patronized stops at the Los Angeles City Hall and the U.S. Courthouse. This "bus bottleneck" was stuck not only at weekday rush hours but also when buses bound for the Dodgers Stadium filled the lane.

Passenger Difficulties. On the City Hall and U.S. Courthouse blocks, buses of 29 different routes arrived at irregular

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[1] LADOT & SCRTD, 1980.
[2] LADOT & SCRTD, 1980.
[3] LADT, 1974, p. 17.
[4] LADT, 1975.
[5] LADOT & SCRTD, 1980, p. 3.

intervals. This pattern resulted in lengthy queues of up to ten buses (sometimes backing into First and Temple Streets) so that route stops were unpredictable. While RTD operating procedures mandate that only the first three buses in a queue may open doors to commence boarding, some bus drivers behind the first three would open their bus doors to save time. However, these fourth-through-tenth position buses would often not make a second authorized stop for boarding when they were able to lurch forward into one of the first three positions.

Naturally, the only sensible way for a waiting rider to adapt to this unpredictability was to run to his or her bus, whatever its queue position and stand by it until it opened its doors, sometimes necessitating running forward to follow the bus into a "first three" position if boarding had not already begun. If one multiplies this individual behavior by the many riders congregating in front of City Hall and the U.S. Courthouse, it is possible to visualize the occasional resultant scene--clusters of riders running to, and chasing after buses through other expectant clusters of riders waiting for other routes, all apprehensive that their bus would pass them by. This was not only bad for waiting passengers but double-stopping by buses caused additional delay.[1]

C. <u>Implementation of Change (1979)</u>

1. <u>Spring Street Contra-Flow Lane Widening</u>.

The contra-flow lane (originally 12-13' wide) was widened to 21'-26', between First and Macy Streets to provide for a passing lane with favorable turning radii in front of City Hall and the U.S. Courthouse (see Figure IV-11). This lane widening was implemented without reducing the number of lanes for the southbound traffic at Spring Street intersections; this number remained at five north of First Street and four south of First.

The retention of southbound lanes at intersections was accomplished by subtly thinning the southbound lanes, reducing the number of through lanes north of First to four, while effectively preserving a fifth lane at the intersection in the form of a left-turn pocket.[2]

The advantages of this lane doubling were: 1) it allowed buses to pass any broken or otherwise delayed bus, and 2) it permitted skip-stop operation with alternating stops for Busway and non-Busway buses (see Figure IV-13). The clear segregation of Busway versus non-Busway bus stops reduced passenger confusion and tended to reduce bus queue lengths as well.

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[1]LADOT & SCRTD, 1980.
[2]LADOT & SCRTD, 1980, p. 10.

Motorist awareness of the widened contra-flow lane was provided by two new overhead bus lane signs at First and Temple. Diagrams of these signs are shown on Figure IV-15. To offset any southbound traffic problem caused by changing the left-hand southbound lane into left-turn bays, revisions were made in signal timing and coordination at First, Temple, and Aliso Streets resulting in more morning southbound "green time." An additional, third lane was provided for westbound traffic on First Street by eliminating peak period parking. This additional capacity was needed to compensate for the "green time" gained by Spring Street at the expense of First Street.[1]

2. New High Street Routing Changes

At the request of the SCRTD, the contra-flow lane was extended one block north up New High Street between Macy and Ord Streets. This block of New High Street, a northerly extension of Spring Street, had formerly been one-way southbound. In November 1979 it was changed to a normal two-way street.

This new arrangement permitted four SCRTD bus lines (#7, 24, 25, 56) to bypass several congested intersections at which they had to make turning movements. The new routes via the two-way block of New High Street, involved minimal disruption to business. Bus stop and route revisions involved in this re-routing are shown on Figure IV-14.

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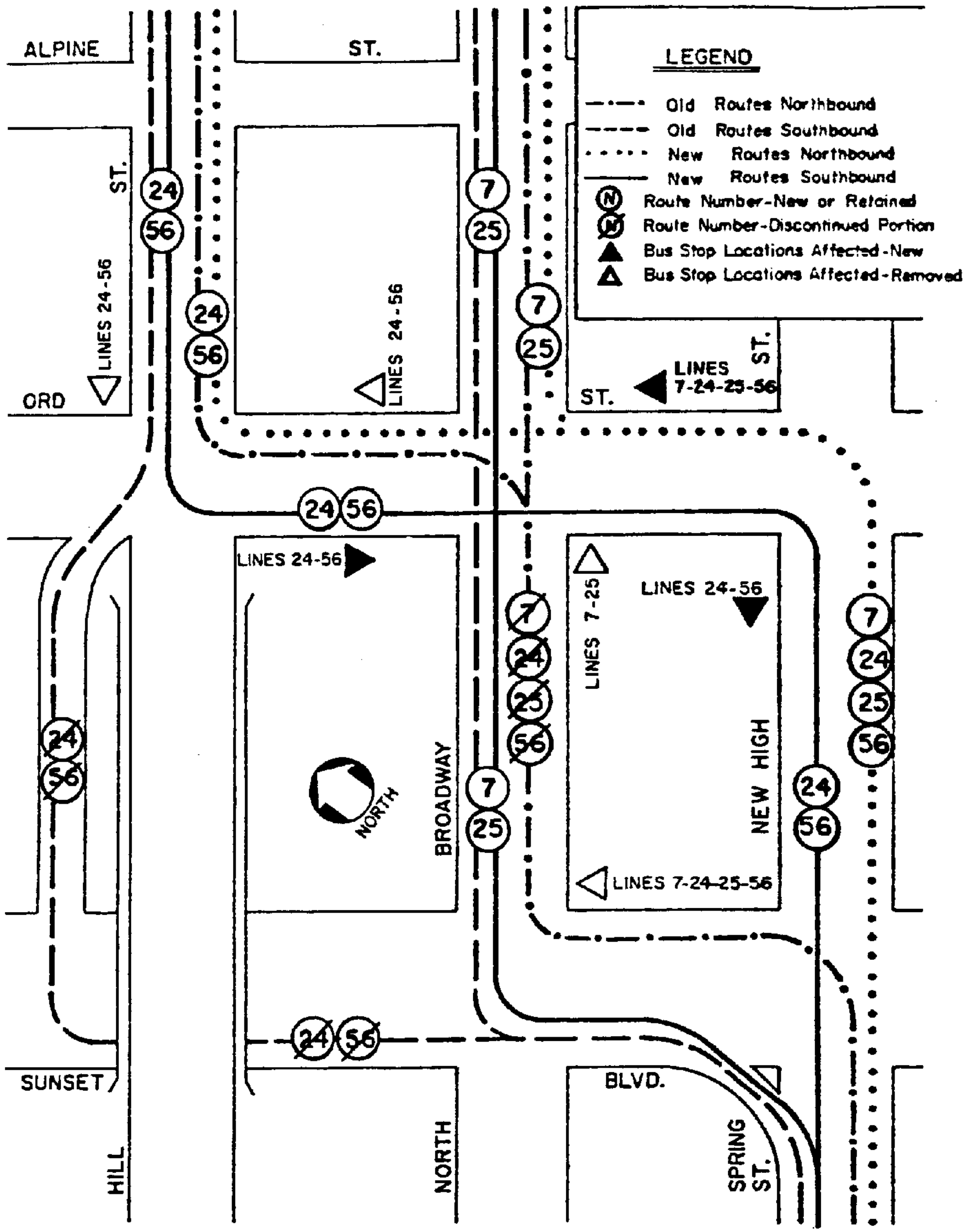
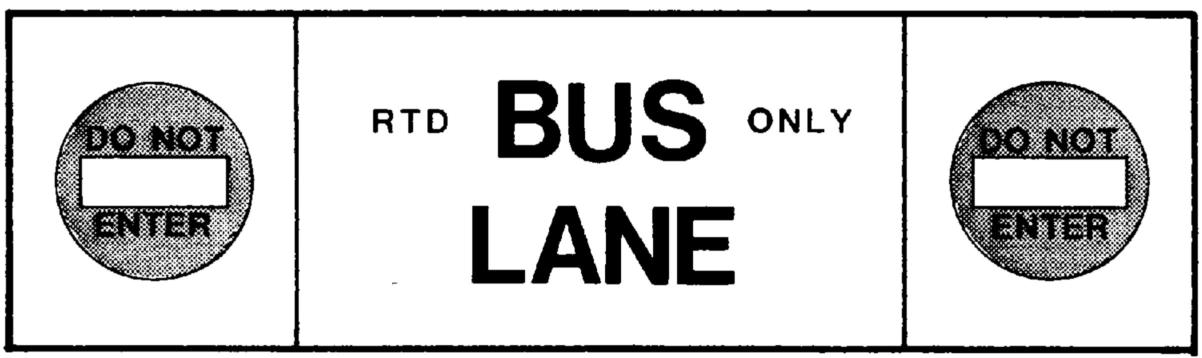
[1] Ibid.



NEW HIGH STREET REROUTINGS AND BUS STOP REVISIONS

From Evaluation of the Spring Street Contra-Flow Bus Lane Widening and Re-routing of Buses on New High Street LADOT and SCRTD, December, 1980.

Figure IV-14



OVERHEAD LANE SIGN

FIGURE IV-15

VII. IMPACTS OF 1979 MODIFICATIONS

A. Data Collection

Point checks were made of bus operation and patronage by City DOT and SCRTD personnel with synchronized stop watches, recording the time each bus passed, northbound and southbound, 7-9 a.m., 11-1 p.m., and 4-6 p.m. Travel times for southbound through traffic were recorded by the DOT's Electronic Recording of Operating Speeds (EROS) vehicle. Manual traffic volume counts were taken at intersections of Spring Street with Arcadia, Temple, and First between 7-9 a.m., 11-1 p.m. and 4-6 p.m. Photographs and field observations were also taken to help analyze the effectiveness of the modifications.

B. Contra-Flow Lane

SCRTD survey teams examined the northbound contra-flow lane on November 5, 1979--two weeks before modifications were implemented--and December 10, 1979--over three weeks after implementation. Their findings are summarized as follows:

1. Bus ridership remained the same. On November 5, 8,936 passengers on 239 buses were counted 4-6 p.m. (37 passengers per bus, average). On December 10, 9,010 passengers in 237 buses were counted 4-6 p.m. (38 passengers per bus).

2. Bus travel times improved. The sample "before" and "after" days for this analysis were October 17,1979--one month before implementation--and May 7, 1980--six months after implementation. Surveys, taken by LADOT in the same time periods, were used for gauging ridership and were summarized separately for Busway buses and non-Busway buses. Results are shown in Table IV-II.

3. Safety of the modified operation is apparently unchanged. A preliminary SCRTD survey indicates that eight accidents occurred on the contra-flow lane between First and Macy in the twelve months "after" implementation Of the eight, four involved passengers on board or boarding, three involved collisions with parked or moving vehicles, and one involved a bus/pedestrian conflict. In the year "before" implementation (November 1978 to November 1979), ten accidents occurred on the same segment, six involving passengers on board or boarding, three involving collisions with parked and moving vehicles, and one a bus/pedestrian conflict.[1]

4. Fuel savings and air quality were slightly enhanced in the contra-flow lane. About 540 fewer bus engine hours of

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[1]LADOT & SCRTD, 1980.

TABLE IV-2

SPRING ST. CONTRA-FLOW BUS LANE (7-9AM, 11AM-1PM, 4-6PM)

TIME PERIOD	ORIGINAL WIDTH BUS LANE WED., OCT. 17, 1979					WIDENED BUS LANE WED., MAY 7, 1980					PERCENT DECREASE (–) OR INCREASE (+) AFTER WIDENING				
	FIRST TO ALISO			ALISO TO SUNSET	FIRST TO SUNSET	FIRST TO ALISO			ALISO TO SUNSET	FIRST TO SUNSET	FIRST TO ALISO			ALISO TO SUNSET	FIRST TO SUNSET
	LOCAL	BUSWAY	ALL BUSES	LOCAL	LOCAL	LOCAL	BUSWAY	ALL BUSES	LOCAL	LOCAL	LOCAL	BUSWAY	ALL BUSES	LOCAL	LOCAL
AVERAGE BUS TRAVEL TIMES (DECIMAL MINUTES)															
7-9AM	1.70	1.84	1.73	1.12	2.80	1.61	1.58	1.60	1.1 *	2.71	-5	-14	-8	-2	-3
Number of Buses	82	41	123	92	82	85	54	139	85	85	—	—	—	—	—
11AM To 1PM	1.67	1.78	1.10	1.03	2.72	1.53	1.53	1.53	1.01	2.55	-8	-14	-10	-2	-6
Number of Buses	69	37	106	70	68	67	40	107	67	67	—	—	—	—	—
4-6PM	2.40	2.14	2.27	1.39	3.79	1.85	1.89	1.87	1.17	3.02	-23	-12	-18	-16	-20
Number of Buses	122	142	264	121	121	119	142	261	119	119	—	—	—	—	—
AVERAGE BUS SPEEDS (MPH)															
7-9AM	9.0	8.3	8.9	11.0	9.9	9.5	9.7	9.6	11.2 *	10.2	+6	+17	+8	+2	+3
11AM To 1PM	9.2	8.6	9.0	11.9	10.2	10.0	10.0	10.0	12.1	10.8	+9	+16	+11	+2	+6
4-6PM	6.4	7.2	6.8	8.8	7.3	8.3	8.1	8.2	10.5	9.1	+30	+14	+21	+19	+25
Distance Traveled (Feet)	1350	1350	1350	1080	2430	1350	1350	1350	1080	2430	—	—	—	—	—

* Data collected 6-12-80

From LADOT and SCRTD 1980.

idling take place annually, amounting to an annual fuel savings of 270 gallons. Using figures from the U.S. Environmental Protection Agency's Emission Factors Handbook (p. 3.1.5-3, revised 12/75), the changes resulted in an estimated reduction of bus emissions amounting to 88 pounds annually.[1]

5. Other. The lane widening, plus the changes on New High Street, were estimated by the LADOT as costing betwen $4,000 and $4,500. By adding what amounted to a second contra-flow lane north of First Street, non-Busway buses were largely freed from the chronic backups of Busway buses when the Santa Ana Freeway was jammed. In general, allowing buses to pass each other speeded overall bus movement. The only drawback to the separation of Busway and non-Busway bus stops was that local-to-express transfers required a 300' walk previously unnecessary.[2] But passenger confusion was greatly reduced (see Photograph IV-2).

C. Southbound Spring Street

1. Local bus travel times and speeds on the southbound lanes changed slightly after implementation.

2. Busway bus morning travel times increased from 1.9 to 2.1 minutes, while speeds dropped from 9.1 to 8.1 m.p.h. All day travel times decreased from 9.1 to 8.4 m.p.h.

3. Non-bus vehicluar movement (Arcadia to First Street) improved in the morning with speeds increasing 13% (16.0 to 18.1 m.p.h.) but fell 5% in the p.m. peak and 15.8% at midday (22.2 to 18.7 m.p.h.)

D. New High Street Re-routing

The impact of the New High Street re-routing changes on bus route travel time was inconclusive. Travel time on some routes was reduced and on others was increased, all amounting to less than one minute per bus.

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[1] Ibid.
[2] Ibid.

VIII. ANALYSIS AND CONCLUSIONS

A. Contrast Between Northern and Southern Segments

The northern and southern segments of the contra-flow lane provide different service levels. Hence these two segments are discussed separately.

The southern segment, from 9th to 1st Streets, was demonstrably a slower route than Main Street for northbound buses. There is no reason to believe this has changed. This segment, consisting of one 13' wide lane, is inherently a bottleneck on which any halted bus blocks all buses behind it. This southern segment carries only a small fraction of Busway routes and hence has been of little direct utility to the Busway operation. It is on this segment of the contra-flow lane that commercial activities have been adversely affected. Because the southern segment per se of the contra-flow lane has been of marginal value to bus operations and has reduced the convenience to merchants, it may not be worth retaining. However, it should also be noted that when compared with Main Street, this segment provides the rider with a more secure and pleasant environment at bus stops. Also this segment provides a direct route to the northern segment where there are major bus stops and the loss of the southern contra-flow lane would require the re-routing of those buses back onto Main Street. This would inconvenience riders who transfer from these to other buses on the northern semment of the contra-flow.

The northern segment is quite a different story. It is effectively double-laned (1979) and hence does not act as a bottleneck. It does not interfere with commerce. It moves a much higher volume of buses than the southern segment. Subsequent to the 1979 lane widening, it has also been a faster route for buses than the former Main Street route--1.7 minutes for the First-Aliso stretch versus 2.0 minutes on the former Main Street route.[1] The northern segment of the contra-flow lane has the additional advantage of carrying a heavy volume of buses which otherwise would have to travel on First and Main Streets, which carry heavy peak period traffic. While the unit lane costs in the northern segment apparently were little higher than for the southern segment, it can be concluded that the northern segment has been far more cost-efficient, yielding real travel time benefits.

B. Costs

While precise information on the costs of implementing the contra-flow operation are not available, the only figure

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[1]LADOT & SCRTD, 1980; & LADT, 1974.

ciated with 1974 planning and implementation of the project was $48,519.94. This was the figure given to the LADT by SCAG identifying all costs charged against the project between July 1, 1973 and May 24, 1975.[1] In addition, the LADOT estimated an additional $4,000-4,500 was spent in widening the northern segment and changing New High Street to two-way operation. However, maintenance and enforcement costs are not included in these figures. The LAPD annual estimate ($314,000 in 1974) to enforce lane regulations could not be verified.

As with most TSM projects, the capital expenditure for the contra-flow lane is low. Most of the costs or benefits involved are in operations, routine maintenance, and enforcement.

The SCRTD did not save money nor lose much under the new operational arrangement, which involved many of its buses putting on extra mileage. But no firm estimates can be made of: additional RTD revenue attributable to contra-flow operation, extra RTD operational (supervisory) costs, traffic enforcement costs, maintenance costs, and meaningful values which can be assigned to commercial loss, and to passenger and driver travel time.

C. Transportation Utility of Lane

o The 1980 LADOT/SCRTD survey of the contra-flow lane found that about 9,000 people were carried between 4-6 p.m. in the northern segment contra-flow lane. Roughly half that number were being carried in the southern segment. This compares with 6,300 people[1] moving southbound with-flow on Spring in the same period.

o Busway line #60 (now #496) and interurban #420 suffered an operational speed loss and the addition of .6 mile of route with little compensation. These lines might have been either retained on Main Street or entered Spring via Fifth Street.

o No conclusions can be drawn from the accident data about the comparative safety or lack of it on the contra-flow bus lane.

o The project highlights some of the problems of contra-flow bus operations and their limited utility--applicable where sufficient with-flow capacity remains, commercial operations are not seriously hampered, 18' or more is provided in width to

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[1]LADT intradepartmental memorandum, 6/25/75, T.K. Primeto to S.S. Taylor.

[2]2,000 autos/lane @ 1.4 persons per auto during the 4-6 p.m. period estimated by LADOT amount to 2,800 people. In addition about 3,500 were on southbound buses (175 buses x 20 passengers per bus) LADT 1974 estimate.

allow for passing, and where a sufficient passenger volume warrants implementation.

o Despite some problems, the <u>northern</u> segment of the contra-flow lane, from First to Macy Streets, works and seems to have demonstrable advantages in bus speed, reliability, and people movement over former with-flow operation. It is well situated where all Busway routes run, is sufficiently wide, has skip-stop operation, and carries a high volume of buses. However, it was not until five and a half years after the start of contra-flow operation that the necessary changes were made to make this segment work.

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16. William McPhillips, "Spring Street Merchants Upset At Contra-Flow," Los Angeles Times, June 14, 1974.

17. Irv Burleigh, "Contra-Flow Lane Is Slow, Traffic Chief Asserts," Los Angeles Times, June 14, 1974.

18. "LA Businessmen Urge Halt to Contraflow Bus Experiment," Los Angeles Times, December 13, 1974.

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V. CONNECTICUT COMMUTER PARKING PROGRAM CASE STUDY

I. BACKGROUND INFORMATION

In the late 1960's, the Connecticut Department of Transportation (ConnDOT) noticed that drivers were parking at expressway interchanges and then carpooling to work. These vehicles were often parked illegally, and in locations that created traffic hazards. Most of the interchange parking occurred in the southwestern part of the state, in areas adjacent to the Merritt Parkway (State Route 15) and the Connecticut Turnpike (I-95), between the New York State line and New Haven.

As part of its efforts to develop comprehensive long-range transportation plans for the State, the Bureau of Planning and Research at ConnDOT recognized the possibility of properly developing free commuter parking lots at expressway interchanges. It was hoped that development of these lots would facilitate parking at interchanges to encourage carpooling, decreasing commuter trips and reducing traffic congestion and air pollution.

II. PROJECT PLANNING AND IMPLEMENTATION

A. Program Planning and Development

Planning for the commuter parking lot program began in the summer of 1969, when ConnDOT's Division of Transportation Planning inventoried parking behavior at all expressway interchanges in the State to determine the extent and location of commuter parking. Following this inventory, a postcard survey was conducted by ConnDOT and a consultant at 69 interchanges where parked cars had been observed to determine why motorists left their cars in these locations and what their origins and destinations were. For locations of interchange parking, see Figure V-1.

Survey results indicated that although the origins of interchange parkers were dispersed throughout the State, destinations were concentrated at major employment centers such as Hartford, New Haven, and Stamford. This finding was consistent with survey answers concerning trip purpose which confirmed that 93.6 percent of the trips of individuals parked at interchanges were journey to work trips and 3.2 percent were other business trips. The average trip length was 36 miles. Eighty-eight percent of the respondents participated in carpooling and 10.8 percent used public transportation after parking at the interchange.[1] Motivations for interchange parking and carpooling varied: Thirty-nine percent considered the cost of the trip as the most important reason for parking at interchanges, while 25 percent regarded the length of the trip as being the most important factor (see Figures V-2 and V-3).

In March and April of 1970, aerial photographs were taken at interchanges with parking potential, those where a demand for commuter parking was apparent and where State property existed for a lot.[2]

The 69 interchanges which had been identified in the earlier field check were analyzed in terms of demand site availability, zoning, anticipated construction, cost, and local opinion. On the basis of this evaluation, a final list of recommendations was prepared (see Table V-1), which grouped potential sites into three categories. The "present usage" category included locations presently being used by commuters for parking near interchanges, and was further subdivided into sites recommended for improvement for construction of new lots. The "no present usage" category were considered as potential

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[1]Transit use was limited to Darien, where two railroad stations are close to interchanges on I-95.

[2]Planning For The Future: Expressway Interchange Parking Study In Connecticut, ConnDOT, 1970, p. 9.

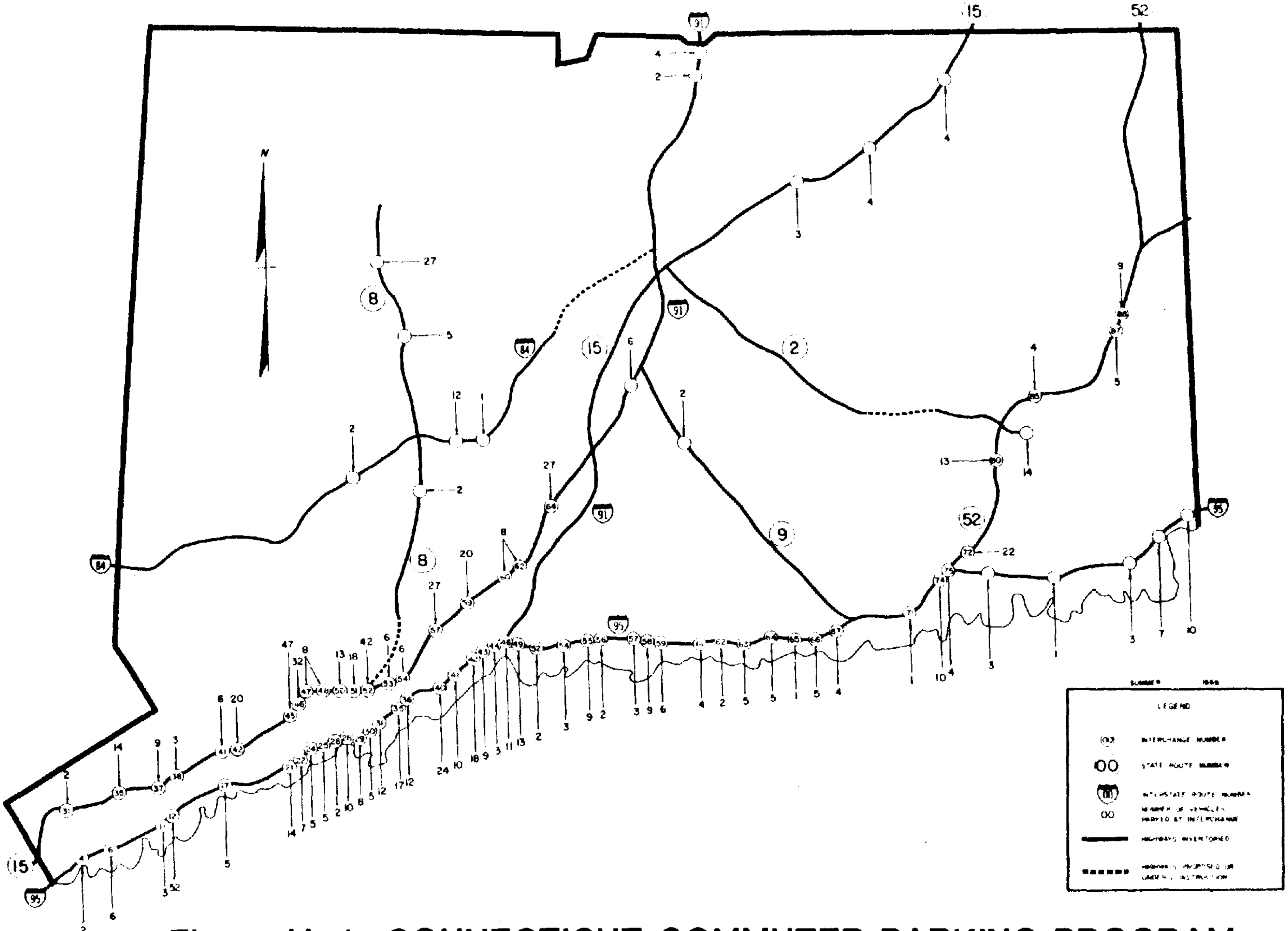


Figure V-1 CONNECTICUT COMMUTER PARKING PROGRAM

LOCATIONS OF INTERCHANGE PARKING

CONNECTICUT COMMUTER PARKING PROGRAM
Key for Figure V-1

INTERCHANGE PARKING - FIELD CHECK (Summer, 1969)

Route and Town	Intersecting Route	ID No.	Vehicles Parked
CONN. 2			
Norwich	New London Turnpike	81	14
CONN. 8			
Naugatuck	Conn. 63	01	2
Thomaston	U.S. 6/202	02	5
Harwinton	Conn. 118	03	27
CONN. 9			
Middletown	Conn. 155	01	2
CONN. 15			
Greenwich	North Street No. 1	31	2
Stamford	Conn. 104	33	9
Stamford	Conn. 137	35	14
N. Canaan	Conn. 124	37	9
Norwalk	Conn. 123	38	3
Westport	Conn. 33	41	6
Westport	Conn. 57	42	20
Fairfield	Conn. 58	45	47
Fairfield	Conn. 59	46	32
Trumbull	Park Ave. & Conn. 25	47, 48	8
Trumbull	Conn. 127	50	13
Trumbull	Conn. 108	51	18
Trumbull	Conn. 8	52	55
Stratford	Conn. 110	53	6
Milford	Milford Parkway	54	6
Orange	Conn. 34	57	27
New Haven	Conn. 69	59	20
Hamden & New Haven	Conn. 10 & 10A	60, 62	8
Wallingford	Conn. 150	64	27
Vernon	Conn. 31	98	12
Tolland	Conn. 74	100	4
Union	Conn. 190	105	4
CONN. 52			
Waterford	Conn. 85	77	22
Norwich	Conn. 82	80	13
Norwich	Conn. 97	83	4
Plainfield	Lathrop Road	87	5
Plainfield	Conn. 14A	88	9

CONNECTICUT COMMUTER PARKING PROGRAM
Key for Figure V-1
(continued)

INTERCHANGE PARKING - FIELD CHECK (Summer, 1969)

Route and Town	Intersecting Route	ID No.	Vehicles Parked
INTERSTATE 84			
Cheshire	Conn. 70	01	1
Waterbury	Scott Road	02	12
Southbury	Conn. 183	03	2
INTERSTATE 91			
Enfield	U.S. 5	01	4
Enfield	Conn. 190	03	2
Cromwell	Conn. 72	02	6
INTERSTATE 95			
Greenwich	Indian Field Road	4	2
Stamford	Harvard Avenue	6	6
Darien	U.S. 1	11	3
Darien	Conn. 136	12	52
Westport	Conn. 136	17	5
Fairfield	Mill Plain Road	21	14
Fairfield	Round Hill Road	22	7
Fairfield	U.S. 1	24	5
Bridgeport	Fairfield Ave., State St.	25	5
Bridgeport	Wordin Avenue	26	2
Bridgeport	East Main Street	28	10
Bridgeport	Conn. Ave., Stratford Ave.	29	8
Bridgeport	Conn. 113	30	5
Stratford	Honeyspot Street	31	12
Milford	School House Road	35	17
Milford	Plains Road	36	12
Milford	Woodmont Road	40	24
Orange	Marsh Hill Road	41	10
W. Haven	Conn. 162	42	18
W. Haven	Campbell	43	9
W. Haven	First Avenue	44	3
New Haven	Left Frontage Rd. & Right Frontage Road	46	11
New Haven	Stiles Street	49	13
E. Haven	Conn. 100	52	2
Branford	Conn. 740	54	3
Branford	U.S. 1	55	9
Branford	Leetes Island Road	56	2

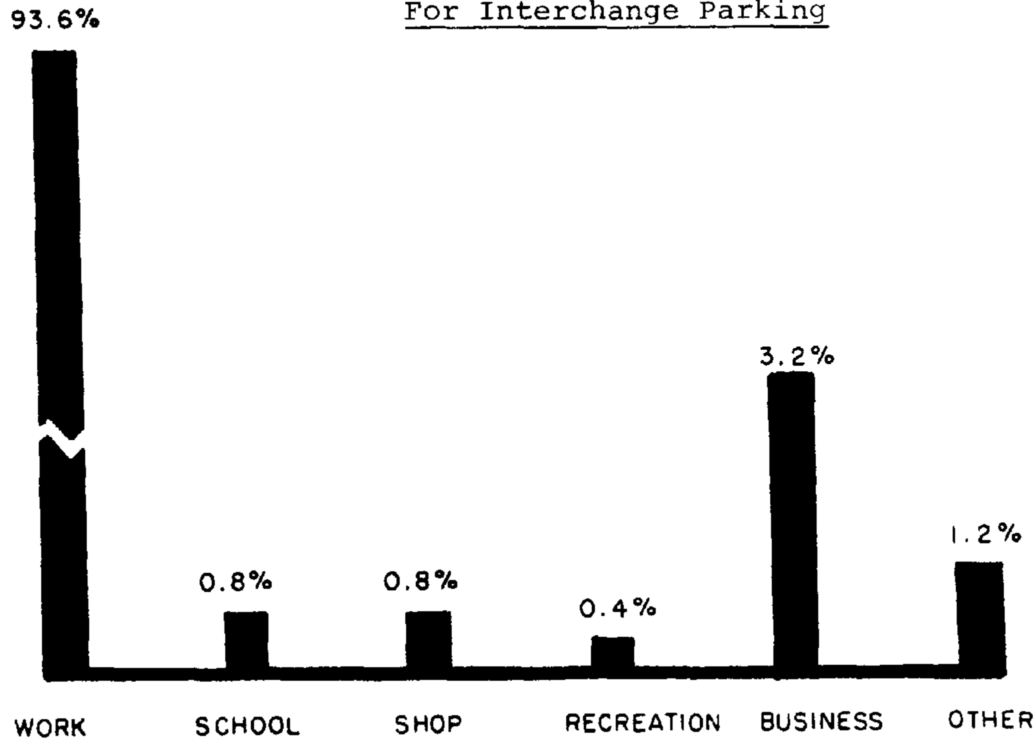
CONNECTICUT COMMUTER PARKING PROGRAM
Key for Figure V-1
(continued)

INTERCHANGE PARKING - FIELD CHECK (Summer, 1969)

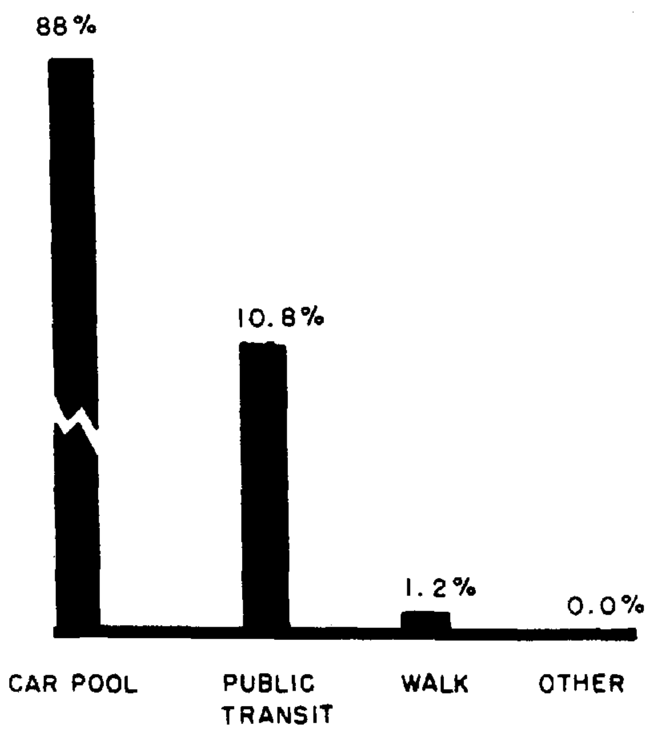
Route and Town	Intersecting Route	ID No.	Vehicles Parked
INTERSTATE 95 (continued)			
Guilford	U.S. 1	57	3
Guilford	Conn. 77	58	9
Guilford	Goose Lane	59	6
Madison	Conn. 79	61	4
Madison	Hammonasset Connector Rd.	62	2
Clinton	Conn. 81	63	25
Westbrook	Conn. 145	64	5
Westbrook	Conn. 153	65	11
Saybrook	Conn. 166	66	5
Saybrook	Conn. 154	67	4
Old Lyme	Four Mile River Road	71	1
E. Lyme	Conn. 161	74	10
E. Lyme	U.S. 1A	75	4
New London	Conn. 85	101	3
Groton	Conn. 85	102	3
Stonington	Taugwank Road	103	3
Stonington	Conn. 2	104	7
North Stonington	Conn. 216	105	10

Figure V-2

Trip Purpose and Mode of Travel For Interchange Parking



TRIP PURPOSE OF INDIVIDUALS PARKING AT INTERCHANGES

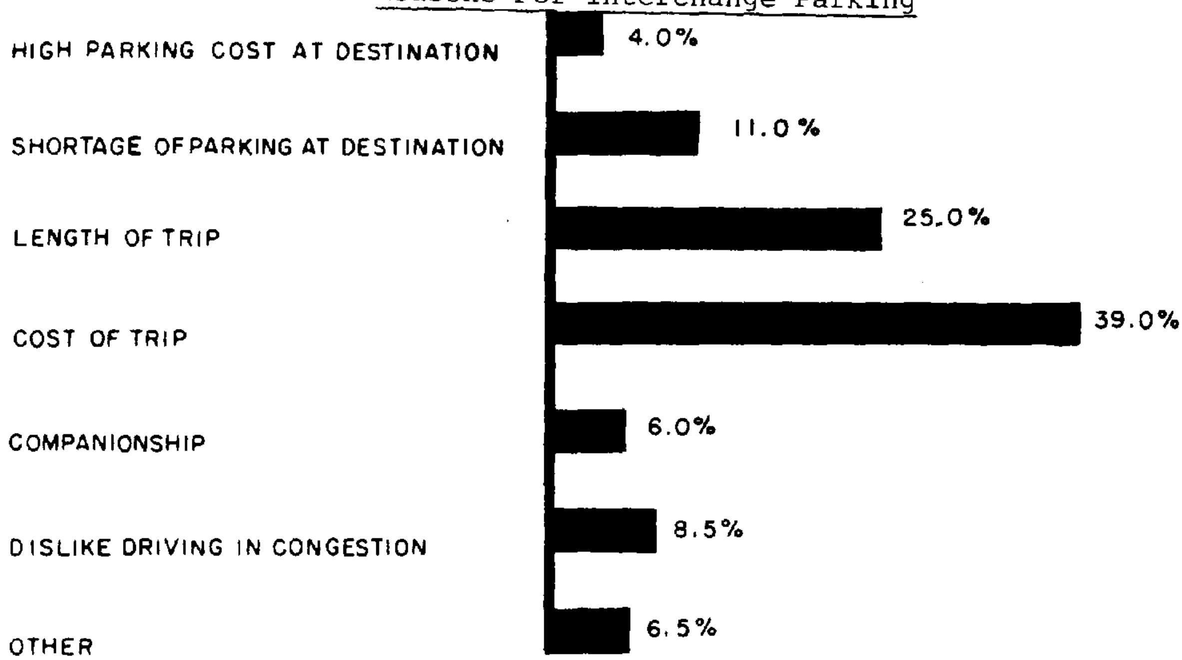


MODE OF TRAVEL AFTER PARKING AT INTERCHANGES

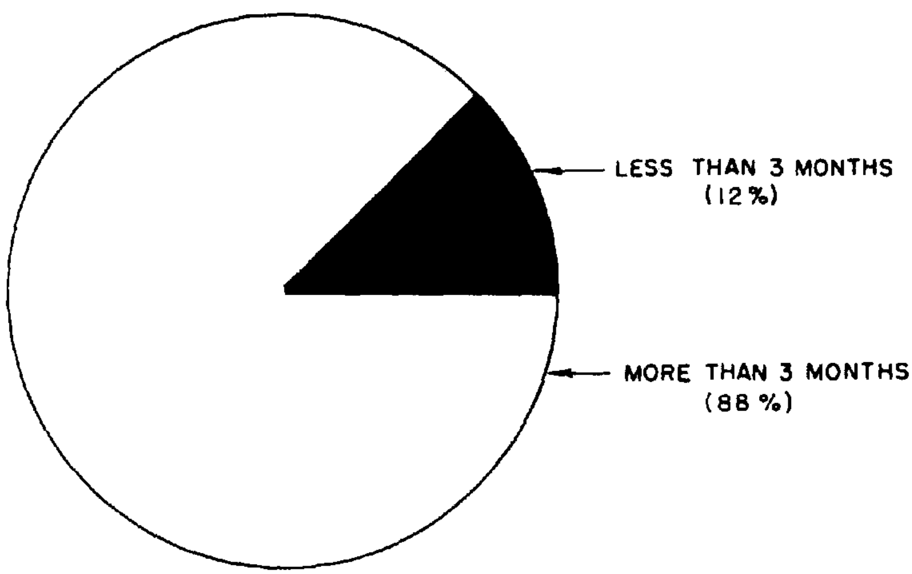
SOURCE: Planning For The Future: Expressway Interchange Parking Study In Connecticut, ConnDOT, 1970.

Figure V-3

Connecticut Commuter Parking Program
Reasons For Interchange Parking



DISTRIBUTION OF REASONS FOR PARKING AT INTERCHANGES
(PRIMARY REASON ON SURVEY FORMS)



DURATION OF INTERCHANGE PARKING AS INDICATED BY USERS

SOURCE: Planning For The Future: Expressway Interchange Parking Study In Connecticut, ConnDOT, 1970.

existed for a lot.[1]

The 69 interchanges which had been identified in the earlier field check were analyzed in terms of demand site availability, zoning, anticipated construction, cost, and local opinion. On the basis of this evaluation, a final list of recommendations was prepared (see Table V-1), which grouped potential sites into three categories. The "present usage" category included locations presently being used by commuters for parking near interchanges, and was further subdivided into sites recommended for improvement for construction of new lots. The "no present usage" category were considered as potential sites for interchange parking facilities. "Future interchanges", where parking lots could be integrated into the design of new interchanges, were also identified.

After reviewing this list of locations, ConnDOT decided to build parking facilities at four interchange sites, which would serve as an experimental or "pilot" program to determine "whether such facilities would gain acceptance and usage by the commuting public."[2] The following locations were selected for immediate parking lot construction:

1. Connecticut Route 15 (Merritt Parkway) and Connecticut Route 34 - Orange.

2. Connecticut Route 52 and Connecticut Route 85 - Waterford.

3. Interstate 84 and Connecticut Route 70 - Cheshire.

4. Interstate 91 and Connecticut Route 159 - Windsor Locks.

The first three locations were chosen because of existing commuter usage, right-of-way availability, and relatively low projected construction costs. The Windsor Locks site had been previously unused but was located along a heavily traveled corridor, and was selected as an experimental lot in an effort to encourage carpooling in the Hartford area.

Construction of these facilities utilized State-owned right-of-way and was carried out by ConnDOT maintenance personnel in order to minimize costs. For lots that were to be constructed on portions of right-of-way of an Interstate or Federal Aid Highway, approval was needed from the Federal Highway Administration (FHWA). Construction of these initial lots included curbing and bituminous concrete surfacing with pavement markings, in contrast to many gravel lots built later.

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[1] Planning for the Future: Expressway Interchange Parking Study in Connecticut, ConnDOT, 1970, p. 9.
[2] Ibid, p. 12.

TABLE V-1
CONNECTICUT COMMUTER PARKING LOT PROGRAM
PRELIMINARY INTERCHANGE PARKING RECOMMENDATIONS

	Proposed Spaces
I. PRESENT USAGE	
A. Improved Existing Parking Area	
1. Conn. 15-Conn. 34, Orange (Int. 58)	100
2. Conn. 52-Conn. 85, Waterford (Int. 77)	60
3. I-95-Woodmont Road, Milford (Int. 40)	25
B. Construct New Lot	
1. Conn. 15-Conn. 59, Fairfield (Int. 46)	50
2. I-95-Conn. 81, Clinton (Int. 63)	50
3. Conn. 15-Conn. 104, Stamford (Int. 34)	50
4. I-84-Conn. 70, Cheshire	60
II. NO PRESENT USAGE	
A. Construct New Lot	
1. I-91-Conn. 159, Windsor Locks	60
2. I-84-South Road, Farmington	100
III. FUTURE INTERCHANGES	
1. Conn. 15-Conn. 8, 108, 127, Trumbull (Int. 52, 51, 50)	100

SOURCE: Planning for the Future, ConnDOT, 1970

Lighting was not provided initially. ConnDOT felt that success of the interchange parking program would depend heavily on an effective promotional campaign. The Department recommended and began an intensive promotional effort before and during lot construction, including the following measures, most of which are still being used:

- o News releases explaining the interchange parking lot program and providing details about newly opened lots.
- o Opening of each lot by ConnDOT and local officials.
- o Installation of directional signs on appropriate roads to provide directions and facilitate lot use.
- o Erection of signs at lot construction sites to identify locations of future free commuter parking lots.

ConnDOT also made provisions for evaluation of the utilization of these initial lots, and indicated that "the decision to construct additional facilities would be based on the results of this experimental program."[1]

The success of the four initial parking areas, as measured by the use of these lots by commuters, was the determining factor in the decision to continue developing commuter parking facilities in Connecticut (see Table V-2). After noting the popularity of the four pilot lots, ConnDOT adopted a commuter parking lot policy, stated as follows:

> "In the interest of reducing traffic on highways, thereby increasing safety and efficiency on these highways, and controlling air and noise pollution, the Connecticut Department of Transportation supports the development and encourages the use of commuter parking facilities at highway interchanges, railroad stations and at other designated places convenient to serve commuters and carpools. It shall be the responsibility of the Bureau of Planning and Research to determine the need and the priority for such facilities. It shall be the responsibility of the Bureau of Administration to seek federal funding to assist in financing such facilities. It shall be the responsibility of the Bureau of Highways to design and construct such facilities. The site planning and design and arrangements for maintenance of such facilities shall be developed by the Bureau of Highways in cooperation with local officials. These lots shall conform to the guidelines and specifications of the Connecticut Department of Transportation."[2]

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[1]Ibid, pp. 3-4.
[2]Development of a Five-Year Parking Lot Program, ConnDOT, May 1980, p. 2

TABLE V-2
CONNECTICUT COMMUTER PARKING PROGRAM
STATUS OF THE FIRST FOUR INTERCHANGE PARKING AREAS AS OF FEBRUARY 10, 1971

	ORANGE Conn. 15 & Conn. 34	WATERFORD Conn. 52 & Conn. 85	CHESHIRE I-84 & Conn. 70	WINDSOR LOCKS I-91 & Conn. 159
1. Date Opened	October 1, 1970	October 2, 1970	October 18, 1970	October 30, 1970
2. Number of Spaces	101	60	60	62
3. Construction Costs				
Labor	$10,927.00			
Material	16,753.00			
Equipment	5,833.00			
TOTAL	$33,513.00	$11,850.00	$11,892.96	$22,845.67*
4. Cost Per Space	$ 332.00	$ 198.00	$ 198.00	$ 368.00*
5. Usage Before Construction	42	22	22	0
6. Usage After Construction (11:00 AM-Wed. of each week)				
1st week	31	17	14	4
2nd week	39	21	17	5
3rd week	36	20	24	6
4th week	46	16	24	6
5th week	52	21	23	3
6th week	41	20	17	2
7th week	44	21	27	1
8th week	49	21	40	7
9th week	52	21	46	10
10th week	41	17	41	9
11th week	51	20	40	7
12th week	35	21	28	6
13th week	38	23	39	-
14th week	49	24	40	7
15th week	48	27	36	-
16th week	43	21	-	-
17th week	35	26	-	-
18th week	40	20	-	-
19th week	47	23	-	

*Does not include costs for landscaping or providing an opening in median.

SOURCE: ConnDOT, Division of Transportation Planning

In June, 1973, at the direction of the Governor and in response to the threat of gasoline shortages, ConnDOT initiated a three point program to reduce fuel consumption, traffic congestion, and air pollution. The program emphasized development and promotion of ridesharing, interchange commuter parking lots, and express bus service. The stated objectives of the program, which remain in force today are:

1. To foster carpooling and charter express bus service (bus-pooling) in private industry through the use of the Department's commuter consultation services.

2. Rapid expansion of the program to construct free parking facilities at interchanges to facilitate carpooling.

3. Rapid expansion of the program to develop express commuter bus service between suburban areas and the central business districts of Connecticut cities.[1]

While the anticipated gasoline shortage, which occurred during the winter of 1973-74, was the impetus for this policy statement, it is significant to note that both the commuter parking lot program and related express bus service pre-dated the events of 1973.

As a result of the three point program, the commuter parking program expanded rapidly. By January, 1974, there were eleven (11) paved facilities with a total capacity of 770 spaces. Express commuter bus service to parking lots, which began in January, 1972 between Corbin's Corner and Hartford, was extended to four other locations during 1972-73.

The most significant expansion of commuter parking facilities occurred during 1974, accelerated by the gasoline shortages during the winter of 1973-74. In response to the gasoline shortages, on February 26, 1974 Governor Meskill announced a "crash" program to develop seventy-one emergency commuter carpool lots at interchanges across the State. Of these seventy-one sites, fifty-five were complete and in operation by July 1, 1974. By June 1975, the number of spaces had increased to nearly 4,400 at 88 facilities, including 32 permanent (paved) and 56 emergency (gravel) lots. The emergency gravel lots were built on available State owned land usually adjacent to interchanges that could be easily converted into parking lots at minimal expense by ConnDOT's Maintenance Office. (Some of these gravel lots were later paved.) As of mid-1975, daily lot occupancy averaged about 49 percent.

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[1]Ibid, pp. 3-4

The Commuter Parking Program has grown substantially since 1975, both in development of new facilities and the upgrading and expansion of existing areas. As demand for commuter parking has grown, the State has built lots at selected locations along State highways, in addition to expressway interchange lots. In some places, where State land is not available or suitable for lot development, ConnDOT has rented parking spaces from shopping centers or churches. By March, 1980 there were 123 parking lots with a total capacity of about 10,420 spaces, and it was estimated that about 7,800 (75 percent) were occupied daily. This high rate of utilization is indicative of the program's growth and success since January 1974, when only 540 of the 770 spaces were used daily. As of spring 1980, 37 of the 123 lots are served by commuter buses, and these bus lots account for nearly 48% of all vehicles parked in the lots each day.[1]

B. Procedures for Identification of Lots and Prioritization

1. Initial Methodology

The location of Connecticut's parking facilities was initially based on results of the following review process:

a. Identification and review of interchange or intersection locations, where commuters parked without a formalized lot, to determine existing and potential needs.

b. Review and analysis of the usage of existing parking facilities in terms of capacity (corridor opportunities) and demand to determine priorities for expansions and improvements.

c. Review and analysis of input submitted by citizens, State and local officials, transit districts and planning regions.[2]

These procedures, used in a coordinated effort by ConnDOT personnel from the Bureaus of Public Transportation, Planning and Research, and Highways, were the primary means of identifying potential areas for new facilities and the expansion of existing lots.

Consequently, facilities were developed at locations where demand was demonstrated by vehicles parked, and where State-owned land was available for site development. However, as the program expanded, the most obvious and easily converted sites

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[1] Lot survey data, ConnDOT Bureau of Planning and Research.
[2] Development of a five-year commuter parking lot program.

were gradually developed. While availability of State property at interchanges is a major consideration in facility locations, it was found that such sites are not always optimal in terms of potential usage. The costs of constructing commuter parking lots increased from $250-$750/ space in 1973-75[1] to an estimated $1,200/space in 1976, exclusive of land acquisition, which could increase facility costs by 300 to 400 percent.[2] ConnDOT had to carefully analyze how to maximize usable locations for parking at interchanges.

ConnDOT also found that counts of vehicles parked in interchange areas did not provide a reliable indication of potential usage and could not be used to establish a priority ranking for facility development. ConnDOT concluded that "the justification for property acquisition and/or facility development is extremely difficult based on existing procedures",[3] and sought to refine its location selection and prioritization techniques.

2. Development of Computer Program For Lot Site Identification (PARKLOT)

In order to develop a methodology for determining potential demand and establishing construction priorities for commuter parking facilities, in 1976-77 the Travel Forecasting and System Development Divisions of ConnDOT's Bureau of Planning and Research conducted a study of commuter parking lot/express commuter bus users. The lot user "windshield" survey (similar to the 1969 survey), conducted at all commuter lots in November, 1976, inquired about the origins, destinations, and trip purposes of drivers using the lots for carpooling. An on-board bus survey was conducted in April, 1977, to provide information on riders' origins, destinations, trip purposes and methods of access. Data collected in these user surveys was used to develop a computer program (PARKLOT) that could forecast usage of potential locations and aid in establishing priorities for the development of commuter parking lots.

Data from these surveys was processed to provide average trip length data for commuter parking lot and express bus users. The most important characteristics of bus and carpool commuter trips were found to be the following:[4]

a. Users of carpool parking lots have an average, door-to-

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[1]Gudaitis and Jain, ITE
[2]"PARKLOT", A Computerized Analyzing Tool for Developing Ridesharing Facilities and Services, ConnDOT, April 1977, p. 2.
[3]Ibid., p. 3.
[4]PARKLOT, pp. 8-14.

door, one-way trip time of about 39 minutes if they drove alone, with most trips over 15 minutes but less than an hour. The average trip from carpool lot to destination by carpool was about 34 minutes.

b. Carpool parking facilities are used almost exclusively by commuters whose trip origin (residence) is located no more than 15 to 20 minutes from the lot (average time 10.5 minutes).

c. Users of commuter bus facilities live an average trip time of only 6.2 minutes from their origin (residence) to the park and ride location, with almost all trips within 30 minutes of their residence.

Based on the survey results, it was determined that the most likely candidates for commuter carpooling were drivers with a one-way daily commute of at least twenty minutes but less than sixty minutes, and that commuters with trip lengths in that range would be most inclined to use parking lots located within fifteen minutes of their trip origin.

Once these commuter trip characteristics had been identified, a computer program (PARKLOT) was developed to locate and identify interchange or intersection locations where commuters converge enroute to their employment destinations. The program uses existing transportation planning programs along with origin-destination trip table records to produce a tabulation of trips destined for a selected area passing through a highway interchange or intersection and satisfying specific parameters (length or travel time). By identifying and collecting trips (of a given length) with a common destination passing through a highway intersection or interchange, it is possible to select commuter parking lot locations with the maximum potential for use.

3. <u>Current Program Guidelines and Implementation Procedures</u>

a. <u>Agency Responsibility for Implementation</u>

In broad terms, ConnDOT's commuter parking policy statement (1970) spelled out the responsibilities of various offices in the planning and implementation of commuter parking lots. The Bureau of Planning and Research was to determine the demand and priority for parking facilities. The Bureau of Highways was made responsible for site planning, design, and construction of lots, and for making maintenance arrangements in cooperation with local officials. The Bureau of Administration was to seek Federal funding for the program.[1]

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[1] <u>Planning for the Future</u>, p. 17.

During the early stages of the program (1970-76), a great deal of emphasis was placed on planning and building commuter parking lot facilities as rapidly as possible. This was particularly the case after the Governor's announcement of the 3-point program of June, 1973. Many promising sites had been identified in the 1970 interchange parking survey, and nearly all of these could use available State land. Consequently, during this period, ConnDOT District Maintenance was used to develop site plans, specifications, and estimates, and Maintenance personnel were responsible for building most emergency gravel lots during 1973-1975 (56 by June 1975). Use of State Land, maintenance personnel and equipment greatly reduced the cost of these lots and the time needed to build them by eliminating the time consuming processes of holding public hearings, soliciting bids, and selecting contractors, which would be needed if the State purchased land for the lots and hired private contractors to build them.

A field design review procedure was developed in the early stages of the program, involving personnel from ConnDOT's Bureaus of Planning and Research, and Highways, and the Federal Highway Administration (FHWA). Once a field review to examine the feasibility of a potential site (identified by the 1970 survey or other means) was completed by ConnDOT personnel, the Maintenance Office of the Bureau of Highways prepared cost estimates for the project based on the review and submitted them to the Bureau of Planning and Research, which would review these plans and submit them for FHWA approval.

However, as the program grew and promising sites suitable for relatively low-cost, easily built gravel lots became fewer, decisions on lot locations became more complicated. The Bureau of Highway's Maintenance Office, subject to budget constraints, found it difficult to perform its other responsibilities in addition to the design and construction of parking lots. These trends resulted in development of more sophisticated procedures for site identification and selection based on PARKLOT, and in more formalized procedures for lot planning, design, and construction.

In January 1980, ConnDOT developed guidelines to encourage the active participation of regional planning agencies and l localities in the planning process for commuter parking facilities. In the first step of the planning process, ConnDOT identifies areas with high potential for use as commuter lots based on the output of the PARKLOT computer program. Next, ConnDOT sends a list of these areas to the planning agency in whatever of Connecticut's fifteen Regional Planning Areas (RPAs) the areas are located, indicating that these have been identified as high potential areas for commuter parking lots. At this time, ConnDOT also notifies the chief officials of the towns in which the areas are located, advising them that the area described has been identified as a potential site for a commuter parking lot. High potential locations are identified for each of the planning regions.

From this list, ConnDOT asks the regional planning agencies[1] to determine feasible sites for the development of commuter lots in the suggested locations, and to coordinate site selection with the towns involved. ConnDOT supplies information on the approximate number of potential commuters and the parking area needed at specific locations. Each site recommended by a regional planning agency requires a field review by ConnDOT personnel from the Offices of Program Planning, Highway Design, and Environmental Planning to determine if it is suitable for a commuter lot location prior to submission for ConnDOT and FHWA approval. Various site location factors are considered in the review, including security, visibility, potential for expansion, development cost, construction feasibility, and access to and from the lot by auto and bicycle.

Once potential lot sites have been identified, the regional planning agencies submit their recommended project sites to ConnDOT, which makes an overall list of commuter lot projects in priority order.

In considering alternative sites within the commuter parking lot program, ConnDOT selects sites partly on the basis of the following priority guidelines:

1. State-owned land should be used whenever possible (as this eliminates costly land purchases and lengthy approval procedures, reducing cost and completion time).

2. Municipally-owned land is the next best alternative for lot sites.

3. Private land will be purchased only if State or municipal land is unavailable at the suggested location.

4. If land acquisition by the above means is impossible or prohibitively expensive, ConnDOT should investigate leasing spaces (a license agreement) from a commercial or institutional property. Determination of lease cost will be based on records submitted by the property owner documenting yearly maintenance, snow removal, and lighting costs, which ConnDOT will share on a pro-rated basis.[2]

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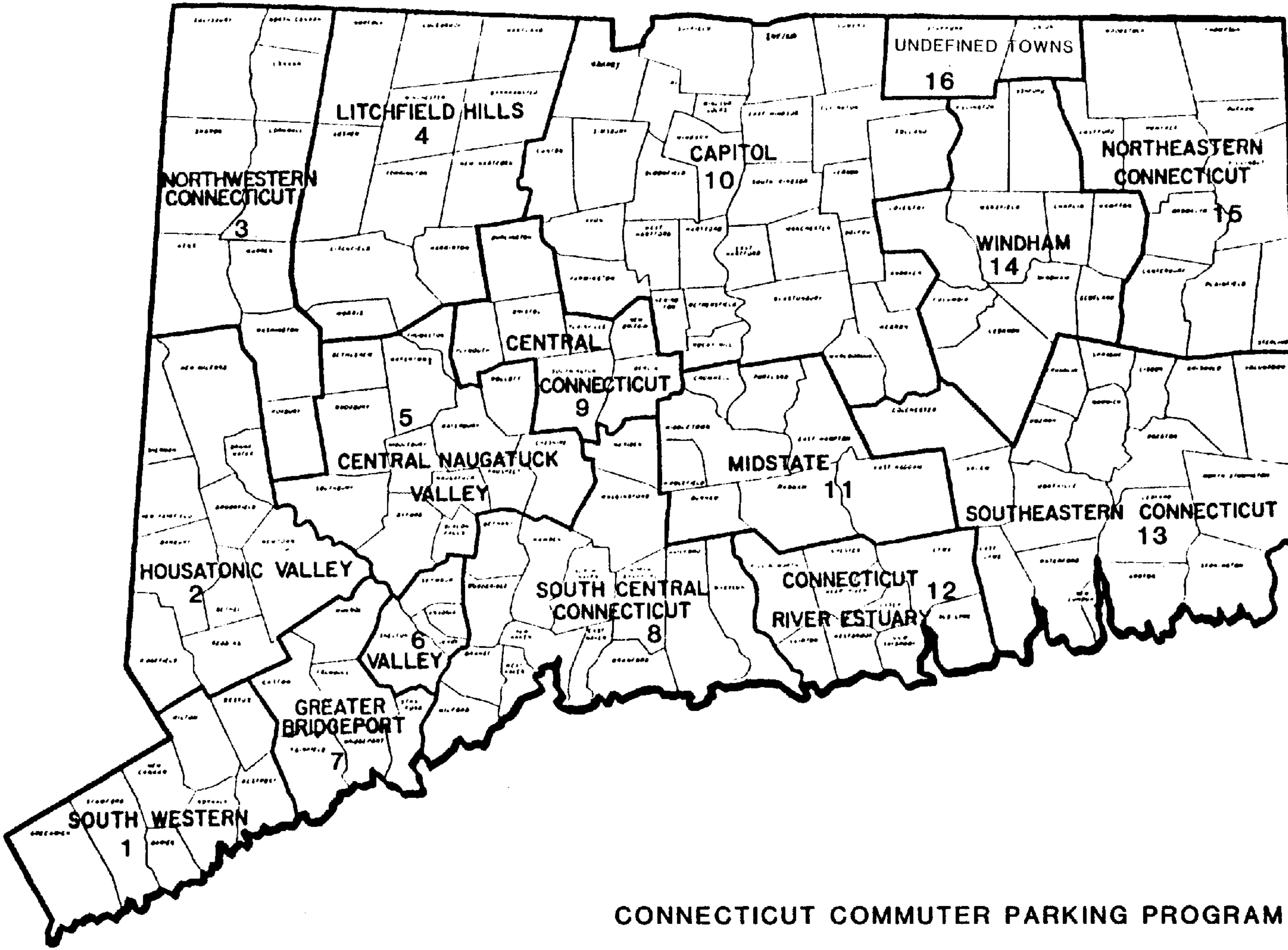
[1]Connecticut is divided into fifteen regional planning areas (RPAs) and one undefined area (see MapV-1).
[2]Development of a 5 year Commuter Parking Lot Program, ConnDOT, May 1980, pp. 9-10.



CONNECTICUT COMMUTER PARKING PROGRAM

Map V-1: CONNECTICUT PLANNING REGIONS

REGIONAL PLANNING AREAS

While these guidelines do not dictate the exact priority ranking of projects, ConnDOT has generally given priority to building low cost gravel lots on State land, expanding and/or paving existing lots, and leasing spaces in parking areas owned by others. This course of action has provided maximum parking capacity at minimal cost over a relatively short period of time as demand has grown for additional facilities.

After the need and priority for a project has been determined and a site has been selected, the Office of Project Planning must prepare a project recommendation form. This is processed by the ConnDOT Division of Program Planning and by the Division of Fiscal and Federal Aid for programming in order to obtain the funding necessary for preliminary engineering rights-of-way, and construction of a proposed lot.

As mentioned previously, during the first few years of the program the Office of Maintenance was primarily responsible for building a large number of gravel parking lots, with its own personnel developing site plans, specifications, and construction estimates. However, as the program grew the Office of Survey and Plans and by the Bureau of Highways (Central Design) took over the design. Most construction is done by contracts awarded by competitive bidding. Some projects which require limited construction such as gravel lots or lot resurfacing, are handled by the Office of Maintenance. If not, the project is awarded to a contractor. Additional coordination of location and construction with the towns involved is provided by Bureau of Highways personnel during the design phase of the project, and local officials are notified that a specific location has been selected for lot construction prior to ConnDOT or FHWA approval.

b. <u>Implementation Sequence and Intergovernmental Coordination</u>

A summary of the step-by-step procedure and ConnDOT agency responsibility for processing individual projects appears below:

a.	Identify sites with high use potential.	Planning (Bureau of (Planning & Research)
b.	Determine priority based on use potential, land availability, local acceptance, and estimated costs.	Planning
c.	Field review site to determine construction feasibility.	Planning, District, Design & Construction Units
d.	Determine lot capacity.	Planning

e.	Plan bus shelters, handicapped parking and bicycle storage facilities with appropriate signing.	Planning & Highways
f.	Estimate preliminary cost.	Planning
g.	Determine construction responsibility - Regular contract Maintenance (concurrence required)	Planning
h.	Submit recommended project.	Planning
i.	Include in TIP.	Planning
j.	Submit work order for preliminary engineering.	Highways
k.	Develop detailed plans, specifications, and cost estimates (P.W.&E.)	Highways
l.	Request FHWA approval.	Highways

Once a commuter parking lot becomes operational, it comes under the jurisdication of the Bureau of Highways or the Bureau of Public Transportation (if commuter bus service is provided). Any problems that arise as a result of lot operations are the responsiblities of these Bureaus.

The intergovernmental relationships and planning and implementation sequence described above are based on the assumption that the facility is built on land which is presently State-owned. Public Act No. 78-50 authorizes ConnDOT to purchase land needed for commuter parking facilities, just as the Commissioner of Transportation is empowered to acquire real property for highway purposes. However, implementation in this manner requires following the same administrative procedures as for highway projects, including provision for public hearings, design review, and competitive bidding,[1] which significantly increase the time needed to complete the project and the cost. Because of the delays and extra expense that these procedures entail, every effort has been made to locate facilities on land already owned by the State. Few (if any) lots have been built

[1]While a formal environmental impact statement (EIS) is not required by FHWA for park-and-ride projects, many State and regional agencies prepare impact assessments to demonstrate compliance with EPA mandated TCPs/RACMs.

on purchased land, and if suitable State land has not been available in appropriate locations, ConnDOT has usually opted to enter licensing agreements to rent parking spaces in existing private lots.

c. License Agreements

License agreements have been used by ConnDOT as a means of establishing commuter parking facilities quickly, particularly in areas where suitable State-owned land is not available. These agreements allow the Department to rent parking space in existing private facilities, such as shopping centers and church parking lots. Generally, commuter express bus service is provided to-and-from these lots. As of May 1980, license agreements were in effect at 16 locations.

License agreements are normally made for a two-year period, subject to cancellation by either party upon 30 days notice. ConnDOT agrees to reimburse the lot owner for services provided such as lighting, snow removal, sweeping, and other maintenance, with the reimbursement fee determined by the percentage of total parking spaces being rented by the State and an estimate of the cost of services being provided by the owner (developed from the owner's cost data). Generally, the State does not pay a fee for the use of the parking spaces.

The Mass Transit Planning Unit of the Bureau of Planning and Research initiates license agreements in conjunction with the development of new commuter express bus services. Typically, license agreements take 90 to 120 days to execute. After an initial three month operational period, the agreement becomes the responsibility of the Bureau of Public Transportation, which also processes all license agreement renewals. The Office of Rights-of-Way is responsible for negotiating the conditions and terms of license agreements.

License agreements have been important in enabling ConnDOT to expand parking capacity quickly, since the process of building a lot, including site selection, acquiring use of the property, design, and construction takes anywhere from 12 to 18 months.

Although license agreements offer an alternative for more rapid provision of commuter parking facilities than new construction, they have generally been considered an interim, medium to short-range solution to commuter parking needs in a specific area. However, as demand for commuter parking lots increases in some congested areas (particularly around Hartford), license agreements may be the only feasible method of expanding commuter parking capacity, since suitable locations are often either too expensive or unavailable.

d. Project Financing

The Federal Aid Highway Program Manual outlines special use highway and transit project categories applicable for lot construction. The following list indicates the various Federal Aid program categories under which commuter parking projects qualify, and the Federal contribution which each category is eligible to receive.[1]

FA Program Category	Federal Share %	State Share %	State Source
Interstate	90	10	Bonds
Interstate Trade-in	85	15	Bonds
Consolidated Primary	75	25	Bonds & Revenue
Rural Secondary	75	25	Normal Revenue
Urban Systems	75	25	Normal Revenue
Safer Off System Roads	75	25	Normal Revenue

ConnDOT makes every effort to utilize Federal programs for financing lot construction to the maximum extent possible. In the past, the Department has been able to recover 75-90 percent of the funding required to develop facilities from these Federal programs. At the State level, Special Act 74-102 passed by the 1974 session of the General Assembly, authorized a $113.7 million bonding program for mass transportation purposes. Section 2C(3) of this act outlined specific applications of these funds with regard to bus commuter parking. Thirty-one million seven hundred thousand dollars was identified for use under Section 2C(3).

Funding for license agreements is allocated by the Finance Advisory Committee (FAC) from the Department's mass transit program appropriation. While license agreements are now financed with 100% State funds, FHWA policies now allow Federal funds to be used for leasing commuter space at private facilities. ConnDOT recently negotiated a license agreement, using Federal funds, to provide 504 parking spaces for express bus service between Enfield and Hartford. The arrangement provides funds for a ten-year period for the use of this facility, with lease payments being used for expansion of the lot. Maintenance costs for lighting, striping, resurfacing, and snow removal are determined separately and paid for with 100% State funds.

e Program Scope and Future Objectives

Recognizing that the demand for commuter parking was growing more rapidly than parking capacity, the Commissioner of

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[1]Development of 5-Year Commuter Parking Lot Program, p.8.

Transportation, in a letter dated January 7, 1980, set a goal to increase the number of parking spaces by nearly 40% (from about 10,000 to 14,000) in 1980, as part of a five-year commuter parking expansion program. Based on this policy, the Bureau of Planning and Research developed goals for the expansion of the commuter parking lot program over the next five fiscal years. The table below summarizes the projected costs and extent of the expansion program for 1980-1985.[1]

Year	New Spaces	Total Spaces	Est. Total Funds Req'd	Est. State Funds Req'd
Existing Program	4,000	14,000	$ 5,600,000	$ 2,800,000
FY 1981	3,000	17,000(+21%)	6,000,000	3,000,000
FY 1982	3,000	20,000(+18%)	6,000,000	3,000,000
FY 1983	2,000	22,000(+10%)	4,000,000	2,000,000
FY 1984	2,000	24,000(+ 9%)	4,000,000	2,000,000
FY 1985	2,000	26,000(+8.5%)	4,000,000	2,000,000
	16,000		$29,600,000	$14,800,000 (50% of Total)

C. Planning and Implementation of Express Bus Service

1. Service Development and Expansion, 1972-1980

Express bus service to commuter parking lots began in January 1972 between Corbin's Corner (West Hartford) and Hartford. With continuous expansion, by March 1980 there were express bus services to 37 of 123 commuter lots (see Table V-3). Between 1974 and 1980 yearly ridership on commuter express services grew from 838,211 to 2,724,206, an increase of 230 percent, accounting for over 40 percent of the growth in system ridership during that period. (See Table V-4 for ridership data.) As of 1980, lots served by express bus accounted for about 48 percent of total vehicles parked in all lots daily. During the period between January 1972 and June 1978, a total of more than 6,500,000 passengers used the express bus system.[2]

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[1] Ibid, p. 5.

[2] Status Report on the Three-Point Program, ConnDOT, Bureau of Planning and Research, June 1978, p. 21.

TABLE V-3

CONNECTICUT COMMUTER PARKING PROGRAM
COMMUTER CARPOOL PARKING AREA LOCATIONS - SPRING 1980

*WITH COMMUTER BUS SERVICE

TOWN	CAPACITY	LOCATION
*ANDOVER	13	Jct. Rte. 6 & Rte. 316
*AVON	180	Rte 44, Caldor's Shopping Center
*BARKHAMSTED	100	Rte. 44, King's Plaza
*BLOOMFIELD	85	Sacred Heart Church
BOLTON	100	I-84 & US 6 & 44A
BOZRAH	12	Jct. Rte. 2 & Rte. 163 & SR 612, Exit 19
*BRANFORD	330	Rte. 1, Cherry Hill Express Bus Lot
BRANFORD	85	Jct. I-95 & Pave St. Garage, Exit 56
BRANFORD	20	Jct. I-95 & Cedar St., Exit 54
*BRISTOL	268	Rte. 6, Mammoth Mart
CANTON	25	Rte. 44, 0.1 Mile West of Rte. 179
*CANTON	35	Rte. 179 @ Town Maintenance Area
CHESHIRE	110	Jct. I-84 & Rte. 70, Exit 26
CHESHIRE	30	Rte. 66, Maintenance Garage
*CHESTER	50	Jct. Rte. 9 & Rte. 148
*CLINTON	100	Jct. I-95 & Rte. 81, Exit 63
COLCHESTER	20	Jct. Rte 2 & Rte. 16
COLCHESTER	39	Jct. Rte. 2 & Rte. 149
*COLCHESTER	225	Jct. Rte. 2 & Rte. 11, SR 637
*COLUMBIA	50	Jct. Rte. 6, Rte. 66 & I-84
COLUMBIA	20	Jct. Rte 66 & West Street
*CROMWELL	100	Jct. I-91 & Rte. 72
DANBURY	175	I-84 Rest Area, Exit 1
DANBURY	35	Jct. Rte. 7 & Wooster Heights Road
EAST HAVEN	30	Jct. Rte 1 & Kimberly Avenue (Lot A)
EAST HAVEN	20	Jct. Rte. 1 & Kimberly Avenue (Lot B)
EAST LYME	60	Jct. I-95 & Rte. 161 Exit 74
EAST LYME	20	Rte. 161, Off Maintenance Garage Drive
*ENFIELD	504	Jct. Rte. 190 & Hazard Ave., Enfield Mall
*ENFIELD	230	I-91 & US 5, Bradlees Stop & Shop
*ESSEX	25	Jct. Rte. 9, Rte. 9A & Rte. 153, Exit 3
FAIRFIELD	55	Jct. Rte. 15 & Rte. 58 (Northside)
FAIRFIELD	30	Jct. Rte. 15 & Rte. 58 (Southside)
FAIRFIELD	210	Rte. 15 & 59
*GLASTONBURY	75	Hopewell Rd. @ St. Augustine's Church
*GLASTONBURY	100	Manchester Rd. @ St. Dunstan's Church
*GLASTONBURY	200	Main St., St. Paul's Church
*GRANBY	100	Rte. 10 & 20 @ St. Theresa's Church
GRISWOLD	96	Jct. Rte. 52 & SR 629 & Rte. 138
GROTON	50	I-95 & Conn. 117
*GUILFORD	113	Jct. I-95 & Rte. 77, Exit 58
GUILFORD	80	Jct. I-95 & Goose Lane, Exit 59
GUILFORD	50	Jct. I-95 & Rte. 1, Exit 57
HARWINTON	30	Jct. Rte. 8 & Rte. 118, Exit 42
KILLINGWORTH	15	Jct. Rte. 80 & 81
LEBANON	20	Jct. Rte. 2 & Scott Hill Road
*MADISON	100	Jct. I-95 & Rte. 79, Exit 61
*MANCHESTER	580	Tolland Tpke., Burr Corners
MANCHESTER	25	Jct. I-84 & SR 502, Spencer Street

SOURCE: ConnDOT Bureau of Planning and Research

TABLE V-3

CONNECTICUT COMMUTER PARKING PROGRAM
COMMUTER CARPOOL PARKING AREA LOCATIONS - SPRING 1980
(Continued)

*WITH COMMUTER BUS SERVICE

TOWN	CAPACITY	LOCATION
*MARLBOROUGH	110	Jct. Rte. 2 & West Rd., Exit 12
MERIDEN	27	Rte. 15 Maintenance Garage
*MIDDLETOWN	95	Rte. 9 @ Eastern Dr., Exit 12
MIDDLETOWN	12	Jct. Rte. 9 & Eastern Dr., Exit 12 (Connecticut Valley Hospital)
*MILFORD	88	Jct. I-95 & Old Gate Lane
MILFORD	45	Jct. Rte. 1 & Milford Connector
MILFORD	35	Jct. Rte. 15 & Wheelers Farm Rd., Exit 55
MILFORD	48	Jct. I-95 & School House Rd., Exit 35
MILFORD	75	Jct. I-95 & Old Gate Lane
NAUGATUCK	50	Jct. Rte. 8 & Cotton Hollow Road
*NEWINGTON	210	Rte 15 (Two Guys Shopping Center)
NEW LONDON	110	I-95 @ State Pier Road
NEWTOWN	56	Jct. I-84 & Rte. 25, Exit 9
NORTH HAVEN	175	Jct. Rte. 5 & Devine Street
NO. STONINGTON	45	Jct. I-95 & Rte. 216 & SR 626
NORWALK	30	Jct. Rte. 15 & Rte. 123, Exit 28
NORWICH	115	Jct. Rte. 52 & West Town St., Exit 82
NORWICH	97	Jct. Rte. 52 & Rte. 82, Exit 80
NORWICH	60	Jct. Rte. 57 & Rte. 97
OLD SAYBROOK	60	I-95, Rear of Former Toll Station
*OLD SAYBROOK	40	Jct. I-95 & Rte. 154, Exit 67
ORANGE	161	Jct. Rte. 15 & Rte. 34
PLAINFIELD	86	Rte. 52 & Rte. 14
PRESTON	36	Jct. Rte. 2A & Rte. 12
SEYMOUR	81	Jct. Rte. 8 @ Lower Derby Avenue
SHELTON	100	Rte. 8 & Bgpt. Avenue
*SIMSBURY	30	Rte. 10, Maintenance Garage
*SIMSBURY	200	Rte. 10, Mitchell's Parking Lot
SOUTHBURY	25	Jtc. I-84 & Rte 188, Exit 16
SOUTHBURY	20	SR 823, 100 ft. north of Rte. 172
SOUTHBURY	30	Jct. SR 823 & Dart Hill Road
SOUTHINGTON	30	Jct. Rte. 10 & SR 597
SOUTH WINDSOR	25	Rte. 5 Opposite I-291
STAMFORD	50	Rte. 15 & 137
STONINGTON	96	Jct. Rte. 2 & Rte. 78
STONINGTON	44	Jct. Rte. 1 & North Main Street
STRATFORD	80	Jct. Rte. 15 & Rte. 110, Exit 53
THOMASTON	30	Jct. Rte. 8 & Rte. 6, Exit 39
TOLLAND	70	Jct. I-86, Rte. 44 & Rte. 74, Exit 100
TOLLAND	100	I-86 & Conn. 195, Exit 99
TORRINGTON	40	Jct. Rte. 4 & Rte. 202
*TORRINGTON	96	Old Rte. 8, Caldors Torrington Parkade
*TORRINGTON	132	Rte. 202, Stars Plaza
TRUMBULL	120	Jct. Rte. 8 & Rte. 108
TRUMBULL	35	Jct. Rte. 15 & Rte. 127, Exit 50
TRUMBULL	70	Jct. Rte. 15 & Rte. 108, Exit 51
TRUMBULL	50	Rte. 25 & Park Street
UNION	20	Jct. I-86 & Rte. 71, Exit 106

SOURCE: ConnDOT Bureau of Planning and Research

TABLE V-3

CONNECTICUT COMMUTER PARKING PROGRAM
COMMUTER CARPOOL PARKING AREA LOCATIONS - SPRING 1980
(Continued)

*WITH COMMUTER BUS SERVICE

TOWN	CAPACITY	LOCATION
*VERNON	250	Jct. I-86 & Rte. 31, Exit 98
*VERNON	200	Rte. 30, 0.5 miles east of Vernon Circle.
WALLINGFORD	25	Jct. Rte. 5 & Wharton Brook Connector
WALLINGFORD	22	Jct. Rte. 15 & Rte. 5 (east side), Exit 66
WALLINGFORD	15	Jct. Rte. 15 & Rte. 5 (west side), Exit 66
WALLINGFORD	53	Jct. I-91 & Rte. 68, Exit 15
WATERBURY	50	Jct. I-84 & Chase Parkway
WATERBURY	17	SR 801, Opposite Scott Road
WATERBURY	43	Rte. 847, 0.2 mile north of Rte. 8
WATERFORD	60	Jct. Rte. 52 & Rte. 85, Exit 77
WESTBROOK	20	Jct. I-95 & Rte. 145, Exit 64
*WEST HARTFORD	275	Rte. 71, Corbins Corner
*WEST HARTFORD	80	Rte. 185 & 218
WEST HAVEN	20	Jct. I-95 & Rte. 122 (First Ave.), Exit 43
WEST HAVEN	25	I-95 & Conn. 162
WESTPORT	42	Jct. Rte. 15 & Rte. 57, Exit 42
WESTPORT	38	Jct. Rte. 15 & Rte. 33, Exit 41
WESTPORT	100	SR 746, 0.3 mile north of I-95
WETHERSFIELD	70	24 Wolcott Hill Rd., DOT Parking Area
WILTON	60	Jct. Rte. 7 & Wolfpit Road
WILLINGTON	100	Jct. I-86 & Rte. 32, Exit 101
WINCHESTER	22	Rte. 44, Barkhamsted Town Line
*WINDHAM	154	Jct. Rte. 6 & Rte. 32, Barkers Dept. Store
WINDSOR	20	Jct. I-91 & Rte. 75
WINDSOR	20	Jct. I-91 & I-291
*WINDSOR LOCKS	150	Jct. I-91 & Rte. 159

Total Capacity = 10,396 spaces.

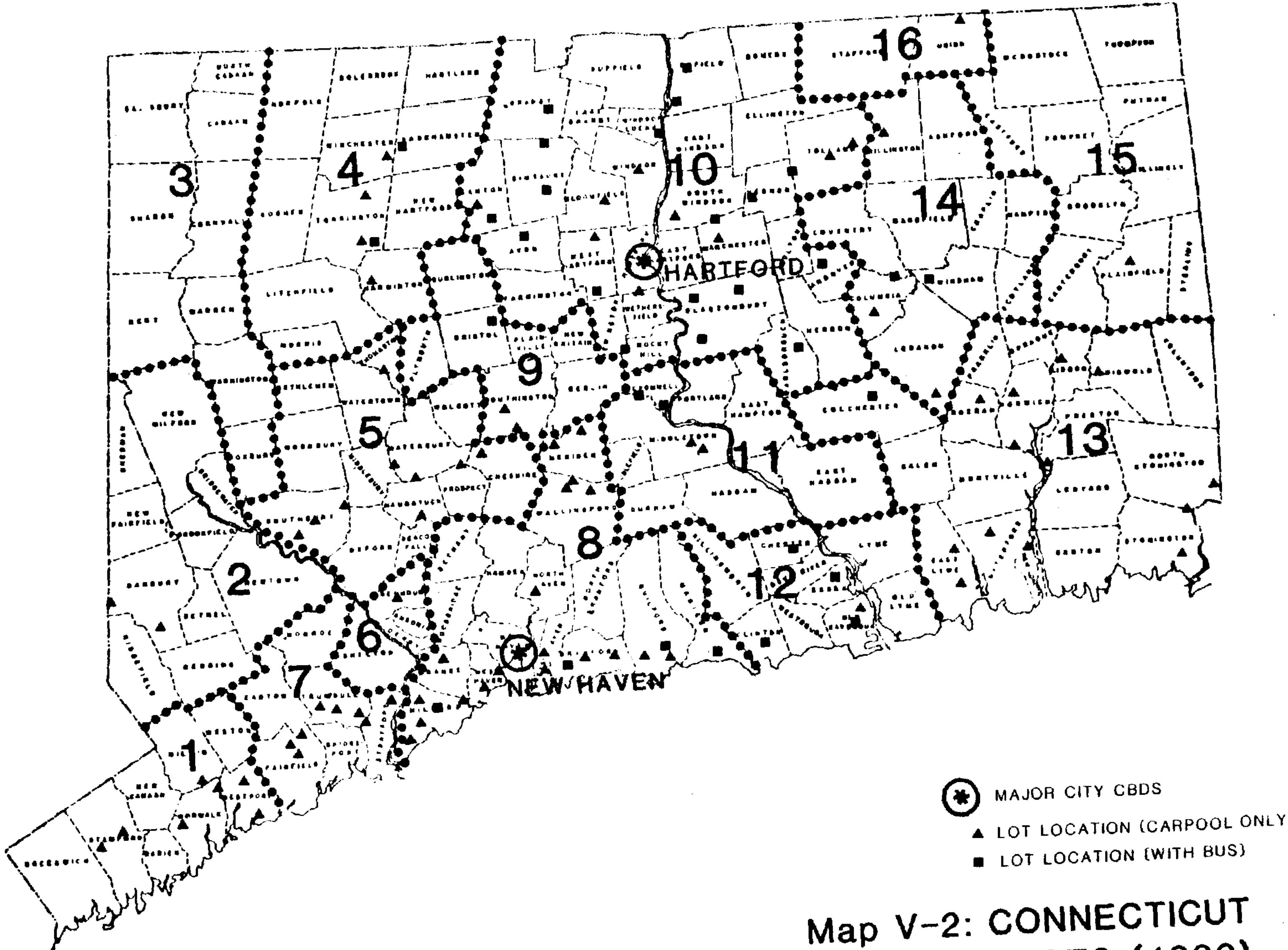
SOURCE: ConnDOT Bureau of Planning and Research

TABLE V-4
CONNECTICUT COMMUTER PARKING LOT PROGRAM
RIDERSHIP - COMUTER EXPRESS SERVICE 1974-1980

Route And Date Service Started	1974	1975	1976	1977	1978	1979	1980
HARTFORD SERVICES							
Bloomfield 6/27/80	-	-	-	-	-	-	11,250
Avon/Canton 7/16/73	126,118	137,839	139,377	151,088	155,095	182,064	191,776
Barkhamsted/Torrington 9/11/78	-	-	-	-	10,899	52,175	67,288
Bristol 4/4/77	-	-	-	55,473	97,573	120,354	134,576
Burr Corners 7/10/72	225,939	256,065	278,015	283,798	278,852	302,301	305,344
Century Hills 1976	-	-	21,418	34,429	35,945	48,597*	61,250
Corbins Corners 1/17/72	163,225	183,281	186,228	183,879	193,539	214,367	194,012
Enfield 1/21/74	106,224	187,477	220,427	268,745	285,144	356,255	417,820
Glastonbury 9/17/73	58,088	82,911	97,464	103,934	122,435	89,057	92,820
Marlborough 6/28/76	-	-	15,884	49,862	59,510	78,965	84,396
Middletown 2/5/74	31,977	63,832	81,648	89,666	96,376	133,093	137,280
Newington 8/17/74	15,237	52,281	56,455	67,478	73,500	93,973	102,232
Old Saybrook (H) 1977	-	-	-	-	32,513	44,377	51,376
Simsbury/Granby 6/12/75	-	46,776	96,271	116,673	138,558	182,489	196,196
Unionville 1976	-	-	23,126	26,493	27,269	42,000*	56,750
Vernon 7/11/77	-	-	-	53,499	143,998	170,078	160,420
Willimantic 2/23/76	-	-	28,712	39,510	38,745	61,712	75,972
Windsor Locks 11/17/75	-	3,898	33,571	41,018	44,941	63,398	110,708
NEW HAVEN SERVICES							
Branford 7/16/73	106,610	112,508	95,445	133,449	149,459	195,139	174,668
Milford 9/23/74	4,793	25,364	21,352	27,781	31,920	43,367	56,472
Old Saybrook (NH) 1/17/77	-	-	-	-	17,728	31,031	41,600
TOTALS	838,211	1,151,232	1,396,393	1,736,775	2,034,989	2,505,565*	2,724,206
% CHANGE		+37.3%	+21.3%	+24.4%	+17.2%	+23.1%	+8.7%

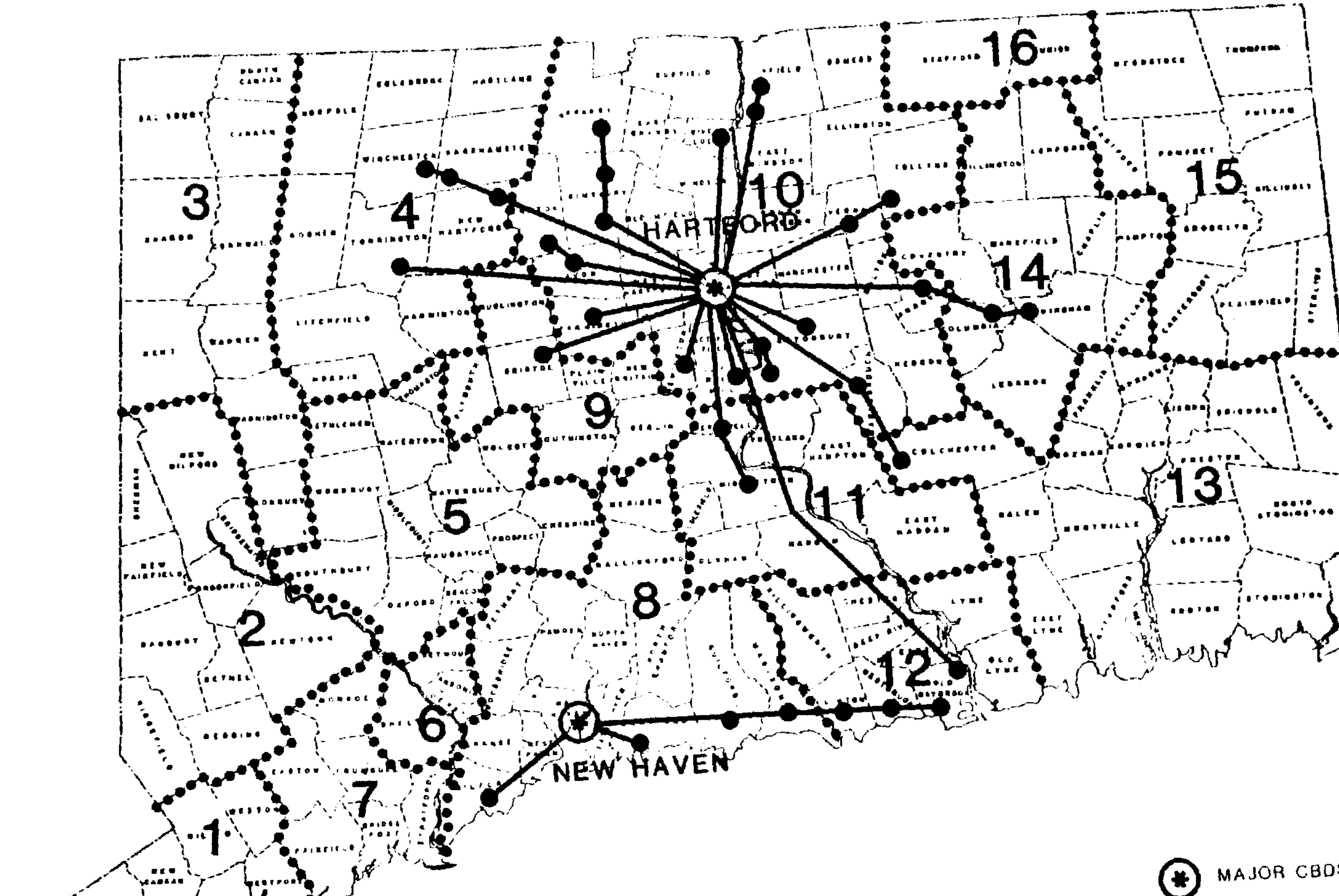
*Data for Century Hills and Unionville was not available for 1979; these numbers are estimates.

SOURCE: ConnDOT Bureau of Public Transportation.



Map V-2: CONNECTICUT PARK AND RIDE LOTS (1980)

NAMES OF NUMBERED STATE PLANNING REGIONS SHOWN ON MAP V-1



Map V-3: CONNECTICUT EXPRESS
BUS ROUTES & PARK AND RIDE LOTS
1980

STATE PLANNING REGIONS SHOWN ON MAP V-1

TABLE V-5
CONNECTICUT COMMUTER PARKING LOT PROGRAM
COMMUTER PARKING LOT UTILIZATION DATA
(Number of Spaces and Parked Cars)
1971-1981

Date	Available Capacity* (Approximate Number of Spaces)	Utilization (Number of Vehicles)	% Spaces Occupied
February, 1971	283	120	42.4%
January, 1974	770	540	70.0%
June, 1975	4,342	2,110	48.6%
January, 1976	7,000	4,410	63.0%
July, 1978	8,510	5,512	64.7%
April, 1980	10,396	7,881	75.8%
May, 1981	11,674	8,978	76.9%

*Includes both carpool and express bus lots.

SOURCE: Status Report on the Three-Point Program, Bureau of Planning and Research, Division of Mass Transit Planning, ConnDOT, June 1978. Data for 1980 and 1981 is from ConnDOT vehicle counts and press releases on lot openings.

TABLE V-6

CONNECTICUT COMMUTER PARKING PROGRAM
UTILIZATION OF COMMUTER PARKING LOTS (OCTOBER) 1977-1980

Planning Area (RPA)	Number Of Lots	Total Occupancy (Bus & Carpool) 1977	1978	1979	1980	1980 Capacity (Bus & Carpool)	1980 % Occupancy
1. Southwestern	6	168	144	160	238	320	74%
2. Housatonic Valley	3	88	72	312	372	266	140%
3. Northwestern	0	-	-	-	-	-	-
4. Litchfield Hills	6	50	50	190	224	420	53%
5. Central Naugatuck	10	280	260	390	368	405	92%
6. Valley	2	44	160	108	136	181	75%
7. Greater Bridgeport	8	308	322	490	460	650	70%
8. South Central	23	850	1122	1292	1370	1642	83%
9. Central	2	120	140	162	256	298	86%
10. Capitol	29	2214	2132	2624	3026	4062	74%
11. Midstate	3	168	168	96	236	207	87%
12. Conn. River	7	150	120	174	266	310	86%
13. Southwestern Conn.	16	504	504	648	723	1124	64%
14. Windham	6	60	60	85	148	405	36%
15. Northeast	1	38	60	54	54	86	63%
16. Undefined Towns	1	-	-	-	4	20	20%
Totals		5042	5314	6785	7881	10,396	75.8%
% Change			+5.4%	+27.6%	+16.1%		

III. PROGRAM OPERATIONS, UTILIZATION, AND COSTS

A. Commuter Parking Lots

1. Overall Utilization Trends

Overall utilization of the commuter parking lot system has grown substantially since 1973-1974. In January 1974, an average of 540 cars/day used eleven lots with a total of 770 spaces (70 percent of capacity). By mid-1980, there were 124 facilities with a total of approximately 10,400 spaces, of which about 7,900 were used daily (75 percent of capacity). Since 1973, lot capacity has increased 12.5 times and utilization (as measured by the numbers of parked cars) has increased 13.4 times, indicating the rapid growth of both facilities and usage. Maps V-2 and V-3 show the 1980 Connecicut park-and-ride lot system.

Table V-5 summarizes data on the growth of commuter lot capacity and utilization. The greatest expansion occurred between January 1974 and January 1976; during this period, over 6,000 spaces were added, and capacity increased from 770 spaces to 7,000. Average daily utilization during this two-year period increased from 540 cars/day (January 1974) to 4,410/day (January 1976). Since January 1976, about 3,400 spaces have been added, increasing capacity from 7,000 to 10,389 (49.4 percent). Average daily utilization increased from 4,410 to 7,881 parked cars/day (a gain of 78 percent) during the January 1976 to June 1980 period.

Table V-6 shows utilization trends for lots grouped by regional planning area (RPA) over the period of October 1977 to October 1980.[1] During this period, there was a 56 percent increase in the number of cars parked, with the largest increase occurring between October 1978 and October 1979 (27.6 percent). Overall lot utilization fell slightly during the second half of 1980.

2. Analysis of Overall Utilization Trends

The large increase in lot utilization over the 1973-1980 period is largely attributable to the interaction of two major developments:

1. Lot utilization has risen as greater lot capacity and more express bus service have been provided. Since

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[1]Comprehensive lot utilization data (including carpool lot data) before 1977 was not available; only data on parking at express bus lots was available for the pre-1977 period. Data provided by ConnDOT Bureau of Planning and Research.

January 1974, about 9,690 spaces have been added, increasing the total number of spaces from 770 to 10,389. Expansion of lot capacity has been uneven over the 1972-1980 period, with an initial phase of rapid expansion (roughly from January 1974 to January 1976) followed by a period of more gradual expansion (January 1976 to mid-1980). During 1974-1976, capacity was expanded quickly with the "crash" lot building program ordered by the Governor in response to the gasoline crisis of 1973-1974, as existing facilities were heavily utilized. The largest increase in utilization (716 percent) corresponds with the greatest expansion of capacity (in percentage terms, 809 percent) between January 1974 and January 1976. Figure V-4 illustrates the concurrent growth of utilization with capacity, although increases in utilization have typically lagged behind capacity expansions somewhat.

Expansion of lot capacity has been slower since 1976 because of difficulty in locating desirable sites (many of which had already been developed), as well as budget constraints. Between January 1976 and March 1980, approximately 3,400 spaces were added, raising the total from 7,000 spaces to about 10,400. This represents an expansion of 48.8 percent spread over four years, in contrast to the 6,000 space increase over the two-year 1974-1976 period. Utilization increased from 4,410 in January 1976 to 7,881 in March 1980, an increase of 78 percent over four years. As the rate of lot expansion has slowed since 1976, so has the growth in facility utilization, despite the gasoline shortages and price increases in 1978-1979.

Relative trends in the growth of lot capacity and utilization also help to explain fluctuations in lot occupancy (i.e., the percentage of spaces filled). Until January 1976, percentage increases in lot capacity exceeded percentage increases in utilization, especially during the January 1974 to June 1975 period when capacity increased seven times, while utilization increased four times. This rapid increase in capacity reduced overall lot occupancy from 70 percent in January 1974 to 48.6 percent in June 1975, stabilizing at 63 percent as the rate of capacity increase fell during 1975-1976. Since 1976, as lot expansion has been slower, percentage increases in utilization have exceeded the rate of capacity expansion, partially explaining the rise in occupancy from 63 percent in 1976 to 74.9 percent in 1980.

2. Utilization of lot facilities has also increased with the rising cost of driving, a national trend

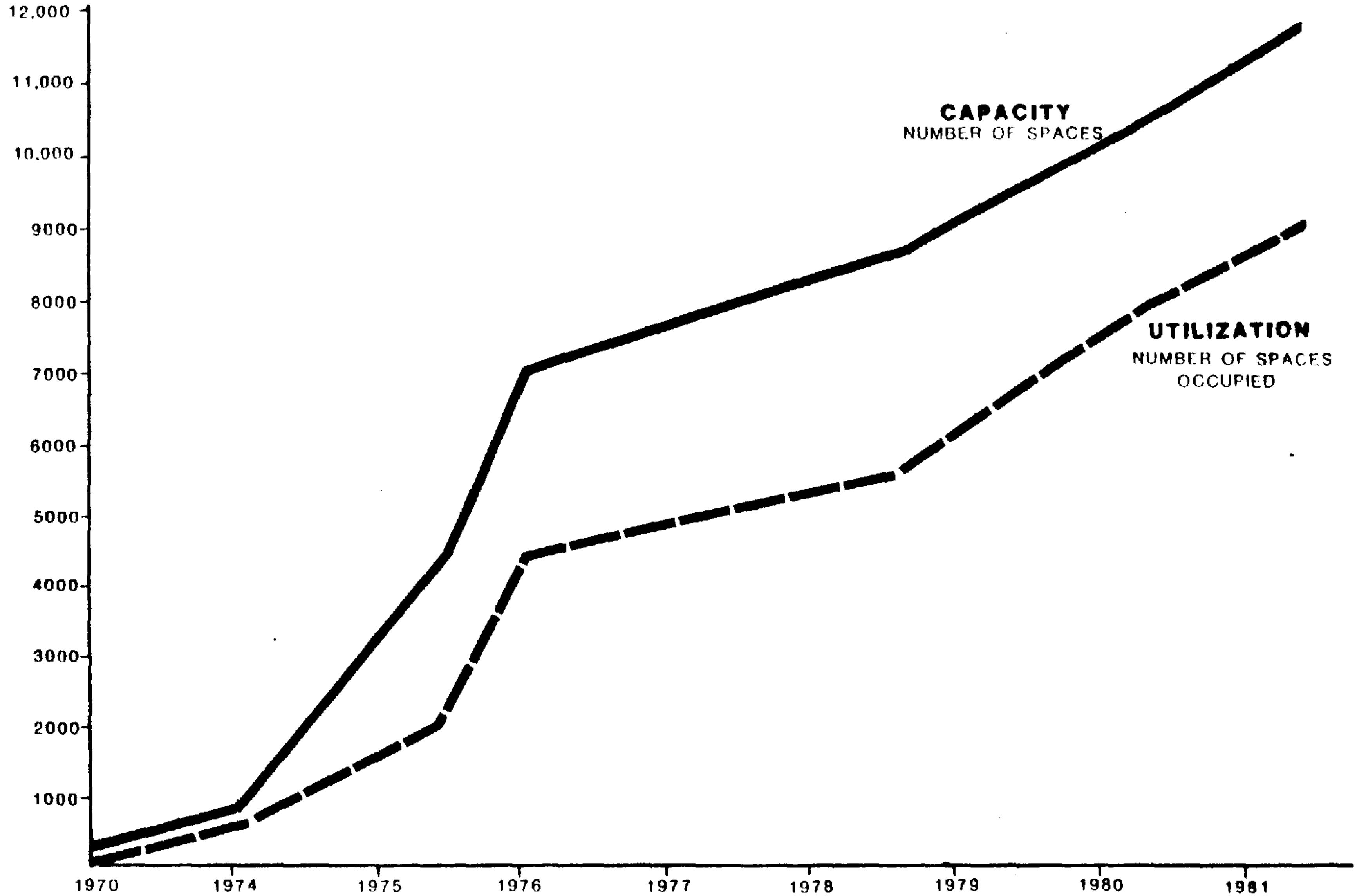

Figure V-4: CAPACITY & UTILIZATION TRENDS, 1970-1981
CONNECTICUT COMPUTER PARKING LOTS (EXPRESS BUS & CARPOOL)

attributable mainly to the enormous increase in gasoline prices over the past ten years (from roughly 30¢/gallon in 1970 to $1.30/gallon in 1980). The threat of gasoline supply interruptions, as in 1973-1974 and 1979, has also been a factor. The increasing cost of operating an automobile (from about 10¢/mile in 1970 to 20¢/mile in 1980) has encouraged ride sharing and the use of express bus service as a means of reducing travel costs.

Lot utilization increased sharply (from 540 to 2,110/day, or 290 percent) between January 1974 and June 1975, a period which partially coincided with the gasoline shortages and price increases of autumn 1973 through the summer of 1974. However, since capacity also increased by 463 percent (from 770 to 4,342) during 1974-1975 (largely in response to the gas crisis), the impact of the shortage in increasing lot utilization in this period is hard to assess.

Another large increase in the number of cars parked (1,272, or 23 percent) occurred between September 1978 and September 1979, coinciding with a 52 percent increase in gasoline prices during 1979, as well as serious gasoline supply shortages, especially in the spring and summer of 1979. During the longer period, from July 1978 to March 1980, utilization increased from 5,512 cars/day to 7,881 cars/day, a gain of 2,294 cars/day, or 41.6 percent. This increase in utilization exceeds the increase in capacity over the same period (from 8,510 to 10,400 spaces, an addition of 1,900 spaces or 22.4 percent), partly accounting for the rising percentage of spaces occupied (from 64.7 percent to 74.9 percent), and indicating that usage increased due to factors in addition to the capacity expansion (specifically, the rising price and uncertain availability of gasoline in 1978-1979). The data suggests that the increase in gasoline prices and the threat of shortages were definitely factors in the steady increase in the number of spaces provided and used during the 1973-1980 period. The threat of higher gasoline prices and shortages was the major stimulus for the rapid expansion of lots and express bus routes in the 1974-1976 period, and seems especially important in explaining higher utilization during the 1978-1980 period.

However, these two trends - increasing lot capacity and express bus service, along with gasoline price increases/supply shortages - do not fully explain the large and steady increase in facility utilization over the entire program. Utilization has steadily increased with lot capacity, though both have risen at a higher than average rate during periods marked by higher gasoline prices and supply shortages. Additions to capacity mandated by State policy encouraged greater utilization both during and after these crisis periods, encouraging ConnDOT to expand lot capacity and provide express bus service. Utilization increases continued long after these crises ended, generally exceeding increases in capacity. Between June 1975 and January 1976, utilization of commuter lots more than doubled (from 2,110 cars/day to 4,410, up 2,300 cars/ day or 109 percent), while capacity increased from 4,342 cars to 7,000, up 2,658 or 61 percent. Expansion was slower between January 1976 and July 1978, with 1,510 spaces added to capacity (a 21 percent increase), and a 20 percent increase in utilization (from 4,410 cars/day to 5,314).

This continuous increase in utilization suggests that while there have been substantial increases in parking lot and express bus usage during the gasoline crises of 1973-1974 and 1978-1979, long term use trends have tended to follow the expansion of lot capacity and bus service. The lag in increasing utilization, which tends to occur after capacity expansions and continues after the crises which motivated additions to capacity, can be attributed partly to changes in habitual home-to-work travel patterns, induced by increasing gasoline prices and shortages. Modal shift from single occupant auto to carpool or express bus tends to occur gradually, as people become aware of the availablity of transit alternatives and their advantages.

a. Factors Conducive To Increased Ride Sharing and Park And Ride Utilization

Previous research[1] has found that certain conditions tend to encourage carpooling and/or the use of express bus park and ride services. These conditions are summarized below:

1. A relatively high concentration of employment in the CBD.

2. High CBD parking costs (i.e., over $1.50/day in 1975 prices or about $2.50/day 1980 prices), and increasing costs of commuting by auto.

3. Serious traffic congestion and frequent delays on major suburb to CBD arterials, and/or major downtown traffic blockages during rush hours.

Not all of these favorable conditions are present in Connecticut. Factors not conducive to ridesharing and park and

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[1] Ride Sharing and Park and Ride: Volume III, Park and Ride Planning Manual, USDOT, November 1977.

ride use include the following:

1. In general, downtown parking costs are relatively low; even in Hartford, the largest city, downtown parking rates average about $2.00-$2.50/day (based on 1980 monthly rates).

2. Downtown parking is generally available, even in Hartford and New Haven, since redevelopment projects have typically made provisions for parking structures, and cleared areas awaiting redevelopment are often used for parking lots in the interim. In Hartford, some of the largest downtown lots have been built by major employers, and about 30 percent of downtown capacity is reserved for use by employees of these firms. A survey of downtown parking facilities conducted by the Hartford Downtown Council in 1977 found that the number of downtown on- and off-street parking spaces had risen from 13,000 in 1969 to 17,600 in 1977, an increase of 35 percent. Over 13,000 spaces were available for monthly rental at rates from $10 to $40, with the average monthly rental about $21.[1]

3. Express buses and carpools do not now receive any priority treatment; there are no HOV lanes or metered ramps for buses anywhere in the state as ConnDOT has found this infeasible.

4. Home to work travel patterns are not sufficiently oriented to central business districts to allow park and ride services to attract more than a very small share (2 to 4 percent) of work trips. Statewide origin-destination survey data indicates that most work trips are within or between suburbs, rather than suburb to CBD, even in the densely populated Hartford area.

5. Household income and access to vehicles are both very high; as of 1976, over half of the households in Connecticut had income over $15,000/year, and 60 percent had access to two or more vehicles. Under these circumstances, it is very hard for transit or ridesharing to compete with direct, single occupant auto trips for the journey to work, which account for 70 percent of all work trips.[2]

Certain trends have tended to encourage ridesharing and/or park and ride usage:

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[1] Downtown Mobility System Study (DMSS), Hartford, Connecticut Downtown Council, April 1978, pages 35-36.
[2] U.S. Census Journey to Work Survey, 1970.

1. Population in Conneticut has become increasingly ex-urban and suburban, requiring longer trips to CBD work sites in which the access travel time advantage of automobiles counts for less.

2. Large scale private development and government sponsored urban renewal programs stimulated commercial development and employment growth in downtown areas, particularly in Hartford and New Haven. In Hartford, major public and private development projects valued at over $300 million have added two million square feet of office space, a civic center/sports arena, two new hotels, and over 250,000 square feet of commercial space since 1970. Large areas of downtown New Haven have also been redeveloped by private interests (mainly retailers), and by an ambitious urban renewal program, with new developments including an indoor shopping mall complex and a new sports arena.

   This has meant more suburb-to-CBD commuting. Census data (1970) confirms this pattern; both the Hartford and New Haven urbanized areas have employment/residence ratios exceeding 1.0, indicating that more people work in these cities than live there, and implying a net inflow of commuter traffic.[1] CBD redevelopment in New Haven and Hartford, accompanied by substantial population growth in outlying suburban and exurban areas too sparsely settled and too distant from the CBD to support comprehensive transit service, have made express bus service and carpooling viable alternatives to driving alone. Increasingly severe rush hour traffic congestion and difficulties in finding convenient downtown parking have also encouraged greater use of carpooling and park and ride facilities, to the extent that in 1970 25 percent of work trips made to the Hartford CBD are made by express bus or carpool.[2]

   While downtown redevelopment has stabilized and stimulated suburb to CBD work trips since the mid 1960s, over the last 20 years most population and employment growth has occurred in suburban areas around Hartford, New Haven, Stamford, Bridgeport, and Danbury, much of it adjacent to major highways. Although the

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[1] Data from CRCOG indicates that 40 percent of the region's jobs are in Hartford, but 61 percent of these are held by people living elsewhere.

[2] U.S. Census Journey To Work Survey, 1976 (based on 1970 Census data.

decentralized commuting pattern dictates that most home to work trips be made by auto, recent increases in the cost of driving as well as the tendency toward longer work trips as residential locations become more remote, have encouraged carpooling to large suburban work locations.

3. The relatively small size of the Hartford CBD (.7 square miles), along with downtown commercial development since the mid-1960s, has created severe rush hour traffic congestion and worsening parking problems. Narrow cross streets downtown, a legacy of the pre-automotive era, have insufficient capacity for peak volumes. While downtown parking capacity has increased (from 13,000 spaces in 1970 to 17,000 in 1977, with about 12,000 open to the public), and capacity is usually sufficient to handle demand, lot utilization varies with location, and the compact street network is often clogged in the A.M. rush hour by queues of vehicles attempting to enter the most centrally located garages. Bus riders, unlike motorists, can walk from the bus to work in the compact CBD and avoid getting caught in traffic congestion.

Interstates 84 (east-west) and 91 (north-south), which carry most of the suburb to Hartford CBD commuter traffic, also have major capacity problems. Ramp capacity is insufficient for weaving movements on I-84 and I-91, and attendant safety problems are widely acknowledged. Rush hour congestion is more severe than on downtown streets, and tends to impede CBD traffic flow. Traffic congestion during peak hours is less severe in New Haven and Stamford, but is already serious and rapidly worsening.

Data from ConnDOT express bus user surveys suggests that in Connecticut, the desire to avoid congested traffic conditions and downtown parking difficulties are factors at least as important in stimulating park and ride usage as cost savings.

The relatively small size of CBDs and suburban areas also tends to limit work trip length, which is a favorable condition for suburb to CBD park and ride operations. With most employment located either downtown or in residential suburbs less than 15 miles from the CBD, most work trips are relatively short (averge about 7.5 to 8.5 miles, one-way). Several studies of park and ride projects have concluded that the greatest demand for express bus park and ride facilities occurs relatively close to the CBD (i.e., anywhere from 4-10 miles), depending on local conditions, and lots closest to the CBD tend to be most heavily utilized.[1]

It has been suggested that park and ride services are more successful in diverting relatively short suburb to CBD auto trips (under 10 miles) because the fact that express buses do not offer travel time savings over automobiles is less important in modal choice for short trips than for longer trips. Consequently, commuters are less likely to tolerate long bus trips if they have an auto, but are more likely to tolerate short bus trips that enable them to avoid the worst congestion (which occurs close to the CBD) and downtown parking problems.[2]

4. Most employment growth in Connecticut has been in the services sector (insurance, finance, and technology).[3] Service oriented businesses tend to be concentrated in CBD or nearby suburban locations, and employ mainly white collar and clerical workers most of whom live in the suburbs. These people are likely candidates for carpooling and express bus programs, because they generally have fixed hours of employment have access.

5. Another factor tending to encourage ridesharing and the use of express bus services has been the high level of public and private support for ridesharing (carpool and vanpool) programs in Connecticut. This support has taken a number of forms. In 1973, the Three-Point Program directed ConnDOT to foster carpooling, vanpooling and charter express bus service (bus pooling) in private industry by providing corporations with computer matching assistance and advice in planning, implementing, and promoting ridesharing arrangements. ConnDOT encouraged private employers to make use of these matching services and to provide incentives for

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[1] Park And Ride Manual, pages 17-18.

[2] "A Study of Transit Fringe Parking Usage," Thomas B. Deen, Highway Research Report, No. 130, Highway Research Board (1966), pp. 1-19.

[3] In 1978, employment in selected nonmanufacturing industries, including finance, real estate, insurance and services represented about 30 percent of all non-agricultural wage and salary employment in Connecticut. During 1970-1978 employment in these selected industries increased nearly 28 percent. The sharpest growth in this group occurred in services, where there was an increase of 42.1 percent or 77,720 additional jobs. Source: Connecticut Occupational Employment Patterns in Selected Non-Manufacturing Industries, Connecticut Labor Department, June 1978.

carpooling (such as reserved parking or free parking). In March 1974 ConnDOT introduced a discount commuter toll ticket book for carpools of at least 3 persons. In addition to administering a carpool matching program for State employees, and providing ridesharing assistance to private firms, in September 1975 ConnDOT started an areawide campaign to increase ridesharing by enclosing carpool applications in all motor vehicle registration renewals. For the one-year duration of the program, 1,622,000 carpool applications were mailed out with registration renewals, yielding 11,500 completed carpool applications, of which 50 percent were matched.[1] ConnDOT also initiated a vanpooling program for its employees in 1976.

As part of Connecticut's EPA-mandated Transportation Control Plan (TCP) to reduce motor vehicle emissions, ConnDOT formulated the Commuter Incentive Plan in 1977, intended to encourage ridesharing in private sector corporations as well as State agencies. The TCP required that these organizations submit action plans for implementation of ridesharing programs. Using State and Federal funds, ConnDOT also began a Vanpooling Assistance Program, which provided vans (30) to be used for pilot vanpool programs at major private employers. A vanpooling program for State employers in the Hartford region was also begun.

3. Parking Lot Costs

a. Construction and operating Costs

Lots built on state property by the ConnDOT Maintenance Office in 1973-75 cost an average of $250/space for gravel lots and $750/space for paved lots.[2] ConnDOT estimated average lot construction costs in 1976 at $1,200/space, excluding property acquisition costs (i.e., assuming construction on State land). The actual cost of building new spaces has been much less for the State than the total cost per space given here, because most of the spaces have been built with the assistance of Federal aid.

For the lots expected to be completed or expanded during 1980, anticipated Federal aid for construction was structured as follows:[3]

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[1] Status Report On The Three-Point Program, ConnDOT, page 10.
[2] Gudaitis and Jain, ITE Journal, 1981.
[3] Cost estimates based on Table III-1, III-2, and A-7 in the 1980 Master Plan.

Spaces Planned	Federal Aid Program	Estimated Total Cost	Federal Share	State Share
584	F2 (Interstate, 90% Federal, 10% State share)	$ 638,000	$574,000 (90%)	$ 63,800 (10%)
460	F7 (Urban system and consolidated primary, 75% Federal, 25% State share)	360,000	270,000 (75%)	90,000 (25%)
75	F9 (70% Federal share, 30% State share)	37,000	25,900 (70%)	11,100 (30%)
	Subtotal	1,035,000	870,100	164,900
432	S1 (100% State funds)	392,000		392,000
1,551	Total	$1,427,000	$870,100 (61%)	$556,000 (38.9%)

Total planned new spaces = 1,250, at estimated cost of $1,270,000

These anticipated construction expenditures were intended to provide nine new lots with 765 parking spaces, expand seven existing facilities by another 485 spaces, and replace two facilities, for a total of 1,250 new spaces (1,551 including replacements).[1] Out of a projected total cost of $1,427,000, the State share came to only $556,000, or about 39% of the total. Put differently, the average unit cost for the anticipated improvements was about $920/space (for 1,551 spaces including replacements), or $1,015/space (for 1,250 new spaces and expansions). The average cost to the State would be $358.50/ space overall, and only $376.85/space for new spaces and expansion, assuming that anticipated Federal grants and State share funds were available. This tabulation of funding sources indicates the extent of program subsidies from the Federal government, which in the past have covered 75 to 90 percent of lot construction costs.

Actual program expenditures by the State in 1980 totalled $448,015 (see Table V-7), about 80% of the estimated State share needed for the entire anticipated program of 1,250 new spaces. By using the ConnDOT Maintenance Office and the

[1]Memo from Arthur Powers, Commissioner, ConnDOT.

TABLE V-7

CONNECTICUT COMMUTER PARKING PROGRAM
COMMUTER PARKING LOTS BUILT OR EXPANDED IN 1980

(1) RPA #	(2) Town	(3) Location	(4) Existing Spaces	(5) New Spaces	(6) Total Spaces	(7) Construction Method	(8) Cost ($)	(9) Cost/Space ($)	(10) Funding State	(10) Funding Federal
2	Danbury	U.S. 7 (White Turkey Rd.)	-	75	75	Contract	$ 66,987	$ 893.16	$ 66,987.00 (100%)	
2	Danbury	U.S. 7 (Federal Rd.)	-	100	100		98,000	980.00	98,000.00 (100%)	
7	Fairfield	Route 58 (2 Lots)	43	42	85		92,708	2,207.33	27,812.40 (30%)	$ 64,895.60 (70%)
8	Milford	Route 15*	35	24	59		68,427	1,159.77*	68,427.00 (100%)	
8	Wallingford	Route 5*	25	54	79		87,068	1,162.37*	26,120.40 (30%)	60,947.60 (70%)
8	Wallingford	Route 68*	53	48	101		62,829	1,308.93*	18,848.70 (30%)	43,980.30 (70%)
10	Tolland	Route 44A	25	42	67(G)		55,000	1,309.52	5,500.00 (10%)	49,500.00 (90%)
12	Old Lyme	I-95	-	28	28		34,843	1,244.40	3,484.30 (10%)	31,358.70 (90%)
14	Mansfield	I-84	-	75	75		76,080	1,014.44	7,608.00 (10%)	68,472.00 (90%)
14	Willington	Route 32	50	50	100		90,000	1,800.00	9,000.00 (10%)	81,000.00 (90%)
14	Columbia	I-84*	40	10	50		50,566	1,011.32*	$5,056.60 (10%)	45,509.40 (90%)
15	Brooklyn	U.S. 6	-	30	30		51,209	1,706.96	5,120.90 (10%)	46,088.10 (90%)
Total			271	578	849	Contract	$833,717	$1,442.41**	$341,965.30 (41%)	$491,751.70 (59%)
2	Danbury	U.S. 7 (Wooster Hts.)	35	60	95	National Guard	$14,300	$238.33	$14,300.00 (100%)	
8	Guilford	U.S. 1	25	25	50		3,703	148.14	3,703.00 (100%)	
8	Guilford	I-95 (Goose Lane)	40	40	80		5,927	148.14	5,927.00 (100%)	
8	Branford	I-95 (Pave St.)	65	20	85(G)		2,963	148.14	2,963.00 (100%)	
13	Groton	Route 117	50	50	100(G)		7,407	148.14	7,407.00 (100%)	
Total			165	195	360	National Guard	$34,300	$175.89**	$34,300.00 (100%)	

TABLE V-7

CONNECTICUT COMMUTER PARKING PROGRAM
COMMUTER PARKING LOTS BUILT OR EXPANDED IN 1980
(continued)

(1) RPA #	(2) Town	(3) Location	(4) Existing Spaces	(5) New Spaces	(6) Total Spaces	(7) Construction Method	(8) Cost ($)	(9) Cost/Space ($)	(10) Funding State	Federal
8	North Haven	U.S. 5 (Devine St.)	75	100	175	DOT Maintenance	$ 50,000	$500.00	$50,000.00 (100%)	
10	Windsor Locks	I-91	85	87	172		45,000	517.24	4,500.00 (10%)	$40,500.00 (905)
11	Cromwell	Route 72	100	60	160		9,000	150.00	9,000.00 (100%)	
12	Essex	Route 9*	25	25	50		33,000	660.00*	8,250.00 (25%0	24,750.00 (75%)
Total			285	272	557	DOT Maintenance	$137,000	$503.67**	$71,750.00 (52.4%)	$65,250.00 (47.6%)
Grand Total			721	1,045	1,766		$1,005,017	$ 961.74	$448,015.30 (44.6%)	$557,001.70 (55.4%)

*Paved and Expanded; cost/space based on total spaces completed.
**Average cost/space for new spaces and spaces added to existing lots.
G = Gravel lot.

SOURCE: Office of Construction and Maintenance, Connecticut Department of Transportation

National Guard, in 1980 1,045 new spaces were built, (1,175 including replacements) at a total cost of $1,005,016. Fewer spaces were completed than expected (1,045 of 1,250 planned new spaces, or 86%), but at a lower total cost ($1,005,016), and at a lower average cost/ space ($934.89 for new spaces instead of $1,015, and $855.33 rather than $920.00 for all spaces including replacements). In 1980, the cost range for providing new spaces was $500 to $2,200 per space for paved lots (average about $1,103 per space) and $150 to $240 per space for gravel lots (average about $176 per space).

As State funds were used to replace reduced allocations from various Federal programs, the State share ($448,015) increased to 44.6% of the total costs rather than the 39% anticipated, so that the average cost per space to the State was $416.75 for new spaces and $381.29 for replacement, rather than the expected $376.85 and $358.50. The spaces completed in 1980 bring the total to 11,595, an increase of 11.3%. While this expansion comes close to that planned in the anticipated program (14.9%), it falls far short of the 25% intended by the Commissioner, or the 4,000 new spaces for fiscal 1980 planned by the Bureau of Planning and Research in its five year plan for commuter parking lots. Rapidly escalating construction and site acquisition costs, as well as reduced Federal aid and greater competition for limited State resources from general revenues and various bonding programs, has forced some curtailment of these expansion plans, even though the commuter parking program is second only to transit operating subsidies for local and commuter services in overall State transportation funding priorities.[1] The State contribution required for lot development expenses has risen to nearly 45% of total costs, up from only 15-20% five years ago, and is likely to rise still more, approximating the 50/50 Federal/State matching ratio projected for the 1980-85 period by the Bureau of Planning and Research.

It is inevitable that as land acquisition and construction costs increase rapidly and available Federal matching funds decline, a larger share of these higher lot development costs will have to be borne by the State. This trend of declining Federal aid for construction also implies that in the future, other areas should not anticipate the high level of Federal support for commuter parking program expansion which Connecticut has received in the past.

Operating Costs

Commuter parking lot program operating expenses for 1980

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[1]ConnDOT, Master Transportation Plan, 1980

were as follows:[1]

Commuter Parking Lot Leases	$ 59,936
Lot Vandalism Deterent Signs	12,500
Bicycle Security Lockers	1,600
Maintenance by DOT	54,000
	$128,036

The cost of leasing spaces depends upon their location. ConnDOT pays about $6,000/year rent for the use of 268 spaces at a shopping center in Bristol, or about $22 per space per year. License agreements to rent spaces in church parking lots are considerably cheaper. Until recently, the State supplied 100% of the funds for license agreements, which are now partially subsidized by a Federal program.

b. Comparative Cost and Use of Various Method of Constucting Commuter Lots

ConnDOT has used State DOT maintenance workers, private contractors, and recently, the National Guard to build commuter parking lots. A comparison of the number of spaces built and average cost per space for each of these methods is presented in Table V-8. In 1980, ConnDOT maintenance workers built 25.3 percent of the new spaces, at an average cost of $621.81/ space. Private contractors built 56.5 percent of the new spaces, at an average cost of $1,431.21/space. The National Guard built four lots with 18.1 percent of the new spaces at an average cost of $166.18/space. The use of DOT maintenance personnel to build parking facilities, which began in the early years of the commuter lot program, has permitted use of standardized designs and construction techniques, expediting lot construction and yielding a substantial reduction in cost per space when compared with costs of private contractors.

Given this cost advantage, ConnDOT has relied heavily on the Maintenance Office to build low cost gravel lots, particularly during the 1973-1975 period. Careful coordination of personnel, equipment, and other obligations of the Maintenance Office has been necessary to insure that lot construction does not interfere with completion of normal road maintenance tasks. Even so, as the lot program has expanded, it has become more difficult to use maintenance workers for lot construction, which is being done increasingly by private contractors at higher cost. With budget and personnel reductions for maintenance programs possible in the future, it will be increasingly difficult to divert maintenance forces from their normal tasks for lot construction. Because the ability of the Maintenance Office and the National Guard to construct new lots is

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[1]From Table IV-2, ConnDOT Master Plan, 1980, p. 50.

TABLE V-8
CONNECTICUT COMMUTER PARKING PROGRAM
COST OF LOTS PLANNED AND BUILT, 1980

RPA	TOWN	COST ESTIMATED	COST ACTUAL	NO. OF SPACES PLANNED	NO. OF SPACES BUILT	COST/SPACE ($) PLANNED	COST/SPACE ($) BUILT	FED./STATE SHARE (%) PLANNED	FED./STATE SHARE (%) ACTUAL	CONSTRUCTION METHOD
2	Danbury	$ 167,000	$ 66,987	75(N)	75(N)	$2,226.67	$ 893.16	100%S	100%S	Contract
2	Danbury	145,000	98,000	117(N)	100(N)	1,450.00	980.00	100%S	100%S	Contract
2	Danbury	-	14,300	-	60(N)	-	238.33		100%S	Maintenance
			Subtotal	192(N)	235(N)					
4	Barkhamsted	97,000	-	100(R)	-	970.00	-	75%F/25%S	-	N.B.
7	Fairfield	-	92,708	-	42(E)	-	2,207.30	-	30%S/70%F	Contract
7	Trumbull	60,000	-	200(R)	-	300.00	-	100%S	-	N.B.
8	Milford	-	68,427	-	24(P+E)	-	1,159.78	-	100%S	Contract
8	Wallingford	20,000	87,068	(25)+40= 65	54(P+E)	500.00	1,102.12	70%F/30%S	30%S/70%F	Contract
8	Wallingford	37,000	62,829	75(N)	48(P+E)	400.00	622.00	75%F/25%S	30%S/70%F	Contract
8	Guilford			-	25(N)	-	148.14	-	100%S	National Guard
8	Guilford	20,000	-	(40)+40= 80	40(E)	-	148.14	-	100%S	National Guard
8	Branford	-	-	20(N)	-	-	148.14	-	100%S	National Guard
8	North Haven		50,000	-	100(E)	-	500.00	-	100%S	Maintenance
8	Madison	75,000	-	(100)+100=200	-	750.00	-	90%F/10%S	-	N.B.
8	Meriden	49,000	-	35(N)	-	1,400.00	-	90%F/10%S	-	N.B.
8	Meriden	176,000	-	75(N)	-	2,346.66	-	90%F/10%S	-	N.B.
8	Milford	75,000	-	(75)+15= 90	-	833.33	-	90%S/10%S	-	N.B.
			Subtotal	680	353					
10	Tolland	-	55,000	-	42(N)	-	1,309.52	-	10%S/90%F	Contract
10	Windsor Locks	-	45,000	-	87(N)	-	517.24	-	10%S/90%F	Maintenance
10	Canton	152,000	-	250(N)	-	608.00	-	75%F/25%S	-	N.B.
11	Cromwell	136,000	9,000	(96)+244=340	60(E)	1,416.67	150.00	-	100%S	National Guard
12	Old Lyme	36,000	34,843	30	28(N)	-	1,244.40	-	10%S/90%F	Contract
12	Essex	40,000	33,000	(25)+35= 60	25(E)	-	1,320.00	-	25%S/75%F	Maintenance
13	Groton	-	-	-	50(N)	-	148.14	-	100%S	National Guard
14	Mansfield	60,000	76,080	75(N)	75(N)	1,200.00	1,014.44	90%F/10%S	10%S/90%F	F2 Contract
14	Columbia	31,000	50,566	(40)+10= 50	10(P+E)	620.00	1,011.32	90%F/10%S	10%S/90%F	F2 Contract
14	Willington		90,000	-	50(N)	-	1,800.00	90%F/10%S	10%S/90%F	F2 Contract
15	Brooklyn	51,000	51,209	35	30(N)	-	1,706.96	90%F/10%S	10%S/90%F	F2 Contract
			Subtotal	679	457					
	TOTAL	$1,427,000*	$1,005,017	1,551*	1,045	$ 920.05*	$ 961.74			
		$1,273,000**		1,251**		$1,017.58**				

Key to Symbols:

(N) = New   N.B. = Not built   (R) = Replacement   S = State Funding   F = Federal Funding   (E) = Expansion   (Old) + Added = Total
(P+E) = Pave and Expand
*Includes expansions and replacements.
**For new spaces only.

is limited future expansions will probable be built mainly by private contractors. This implies a considerable increase in cost.

c. The 1980 Construction Program: Planned and Actual

The facilities actually constructed correspond only partially with those planned. Although extensive use of low cost construction methods by the Maintenance Office and National Guard, as well as overestimation of construction costs allowed completion of most of the number of spaces planned at a lower total cost, construction did not exactly follow the anticipated program or the priority ranking given in the 1980 Master Plan.

An examination of lot facilities (new and expansions) built and not built in 1980 provides some basis for the discrepancies between planned and actual construction. The higher than planned percentage of State funds used indicates that certain anticipated Federal grants were not received, and this situation probably influenced decisions on construction (for example, lots in Meriden and Madison, which were planned on the basis of 90% Federal funds were not built). More spaces were built in areas where demand was high and supply was low (e.g. Danbury), and most spaces not built were either replacements for existing spaces (in Barkhamsted and Trumbull) or added capacity in planning areas where demand is evident but many spaces are already available (e.g. Meriden and Wallingford in RPA #8). ConnDOT seems to have opted to build more low-cost spaces (in more remote areas) and fewer high-cost spaces (in urbanized areas) than originally planned, probably because of the restricted availability of Federal funds.

4. Problems Associated With This Strategy

a. Implementation Problems

The amount of State land in suitable locations available for use as commuter parking lots is limited. Future expansion of the program will increasingly require either purchase of private land and/or leasing of spaces from private facilities. Construction of new lots is already expensive and time consuming, even if State land is used. If Federal assistance continues to decline, and availability of DOT Maintenance workers for lot building is reduced so that construction increasingly is done by relatively expensive private contractors costs of new lots to the State are likely to rise more quickly than in the past.

A related problem is the long lead time required for lot construction. As noted earlier, normally 12 to 18 months are needed to select a suitable lot site, acquire land and hold hearings (if necessary), and to design, finance, and build a new lot.[1] By using DOT Maintenance workers and building on State land to the maximum extent possible, ConnDOT was able to build many gravel lots quickly in the early years of the program. As State land and maintenance workers become less available, expansion of the lot program will require rental and/or purchase of land, and more construction will be done by private contractors selected by competitive bidding. This shift away from the use of limited State land and personnel for lot construction will greatly increase completion time due to time-consuming competitive bidding procedures, negotiation of land purchases, and public hearings, if needed.

ConnDOT is aware of these problems. As a result, in January, 1980 the Commissioner formed a steering committee to oversee the Commuter Parking Lot Program, composed of representatives from ConnDOT's Bureaus of Highways, Planning and Research and Administration.[2] The committee was intended to improve coordination of the lot planning process and investigate means of expediting implementation and controlling costs, such as standardization of lot designs and awarding one construction contract for several locations. It is not yet clear whether these measures to speed up lot completion and cut costs are feasible.

b. <u>License Agreements</u>

License agreements, under which ConnDOT rents parking spaces for express bus users at shopping centers or churches, are a low-cost alternative to new lot construction. Presently, ConnDOT leases about 2,900 spaces, or about 25 percent of the 11,595 spaces in commuter lots. Costs are low because ConnDOT does not pay rent for use of the spaces, instead paying for a pro-rated share of maintenance, snow removal, and lighting expenses. Depending upon lot location, maintenance costs (as documented by the owner), and the number of spaces leased, the cost of license agreements varies considerably. The Department pays $6,000/year rent for 268 spaces at a shopping center in Bristol (about $22/space per year), and pays considerably less for rental of church lots ($1,000 for 100 spaces, or $10/space per year) at St. Dunstan's in Glastonbury.

Funding for license agreements is allocated by the Finance Advisory Committee (FAC) from the Department's Highway and Mass Transit appropriations. ConnDOT budgeted $59,936 for commuter lot leases in 1980.[3] Until recently, all license agreements were financed with 100% state funds. Now, ConnDOT is utilizing these FHWA Interstate funds (90 percent Federal share, 10

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[1]Five-Year Parking Program, ConnDOT, 1980.
[2]Internal Memo from Arthur B. Powers, Commissioner of ConnDOT, January 7, 1980.
[3]<u>Master Plan</u>, 1980 Commuter Service Improvements, p. 50.

percent State share) to lease 600 spaces at the Enfield Mall over a ten-year period. ConnDOT has agreed to construct 96 additional spaces (added to the existing 504 for a total of 600), which the Mall's management felt was necessary due to overcrowding, and which were stipulated as a condition for an extension of ConnDOT's rental agreement. For the 600 spaces which ConnDOT intends to rent (504 existing plus 96 to be built), the cost to the State without Federal funding would be $275,000 ($27,500/ year for ten years, including construction of the new spaces), plus a yearly maintenance fee of $5,000 which is based on the number of spaces used and the cost of services provided by the owner. These maintenance expenses for lighting, striping, snow removal, and pavement repairs are determined separately and paid with 100% State funds. Federal aid reduces ConnDOT's share of the expansion costs to 10% of the total, or $2,750/ year, plus the maintenance charges of $5,000/year. With Federal aid, ConnDOT pays only $7,750/year ($2,750 plus $5,000 maintenance) for the use of 600 spaces, or $12.90/space per year. Without Federal aid, it would pay $32,500/year ($27,500 plus $5,000 maintenance), or $54.00/year per space. Even without Federal aid, it is easier and cheaper to expand lots quickly by renting spaces than by building them.

In addition to low costs, license agreements have several other advantages. First, they can be negotiated and implemented in a relatively short period of time (90 to 120 days), much less than the 12 to 18 months required to build a new lot. If the lot is not utilized sufficiently, the arrangement can be terminated quickly (30 days notice is required). If demand for spaces is high, often more spaces can be rented on fairly short notice. ConnDOT surveys show that at shopping centers, lot users generate sales and increase revenues for the stores. The big advantage of license agreements is flexibility; lot capacity can be increased (or reduced) quickly and at minimal cost. Because of the low cost, flexibility, and relatively short period of time (90 to 120 days) needed to lease spaces as opposed to building new lots, in the future it is likely that license agreements will be used increasingly as a means of expanding commuter parking capacity quickly.

Unfortunately, the flexibility of arrangements to lease parking spaces is also a liability. Normally, license agreements contain a clause which allows either party to cancel the lease after giving 30 days' notice. Since construction of a new lot takes a year or more, and negotiation of a new license agreement would probably take 90 to 120 days, ConnDOT would have great difficulty in replacing a leased lot within the 30 day cancellation period. Fortunately, so far no lessors have decided to exercise their option to cancel, although Enfield Mall, which felt that parking for shoppers was being occupied by commuters, threatened to cancel unless ConnDOT acted to provide more spaces.

Other problems have arisen in conjunction with license agreements, notably those of insurance liability and "spill-over" of commuter parking into non-leased areas. License agreements were initially difficult to conclude because of the ambiguous issue of liability for accidents in areas of privately-owned parking lots leased to the State. Several transit operators elsewhere in the U.S., seeking to use license agreements to expand park-and-ride programs have also encountered this problem. ConnDOT dealt with the liability issue by maintaining (at its own expense) one million dollars of liability insurance covering personal injuries and property damage occuring in the commuter parking area at each leased location. The State also assumed all liability for personal injury or property damage claims arising from use of the commuter parking area (which means that if such claims exceed $1,000,000, the claimant's only recourse is to sue the State). This arrangement has permitted ConnDOT to lease space in privately owned facilities without liability problems.

At some locations (notably Enfield Mall), there have been problems with commuters parking outside of the designated leased areas, reducing parking available for shoppers. This "spillover" problem has occurred in several locations and generally has not been serious. However, it has contributed to the reluctance of some private lot owners to enter license agreements, despite evidence from ConnDOT rider surveys that express bus users account for a considerable volume of sales at shopping centers with leased park-and-ride lots.

c. <u>An Unresolved Problem: Vandalism</u>

Vandalism is a major problem at remote commuter parking lots which are active only during rush hours. While the State police have provided some surveillance as part of their normal patrol duties, they are not jurisdictionally responsible for policing the parking areas even though most lots are on State property. The number and dispersion of the lots would make a statewide surveillance program costly and hard to manage. To address the vandalism problem, ConnDOT has directed State personnel to spot check lots in the course of normal business duties, and has allocated $12,500 in 1980 for installation of surveillance warning signs intended to deter vandalism. In 1979, ConnDOT asked municipalities to provide as much local police surveillance as possible. Lots located in areas clearly visible from major roads and streets appear to be less susceptible to vandalism, and ConnDOT has recognized this deterrent factor in selecting lot locations. Installation of lighting at many lots has also helped, and ConnDOT adopted a policy of installing lights at all new lots. The extent of vandalism and auto theft in terms of dollar losses is unknown, as is the effectiveness of these protective measures.

B. Express Bus Service

Express bus service to commuter parking lots began in January 1972 and has coincided with the State's park-and-ride program. With continuous expansion, by March, 1980 there were 21 express bus routes providing service to 37 of 123 commuter lots. Between 1974 and 1980, yearly ridership on commuter express services grew from 838,211 to 2,724,565, an increase of 230 percent, accounting for over 40 percent of the increase in system ridership. The lots served by express bus account for about 51 percent of the total vehicles parked in all lots daily. Between January, 1972 and June, 1978 over 6,500,000 passengers used the express bus system.[1] Most express bus routes provide service to downtown Hartford, although four routes (Branford, Milford, Old Saybrook, and Clinton[2]) serve downtown New Haven, and service to downtown Stamford was scheduled to begin in early 1981.

The express bus service has strong appeal for younger and female commuters, indicating that it is probably used extensively by clerical and staff workers, who tend to work set hours which allow them to take the express bus on a daily basis. ConnDOT surveys found that reducing commuting costs and avoiding driving in congested traffic were the most important reasons people chose express bus service (see Tables V-9 and V-10).

In a 1980 report, ConnDOT's Bureau of Public Transportation documented the cost savings available to park and ride users. While some users also cited difficulties in parking downtown as a reason for using park and ride, it is uncertain how severe this problem really is since downtown parking capacity in Hartford has expanded from 13,000 spaces in 1969 to 17,000 spaces in 1979. Parking costs are low ($1.15-$2.00 daily).

The State may run into difficulty in continuing its express bus operations, which have been a major reason for park-and-ride use. Table V-11 indicates the cost trend for commuter services over the period June 1975-January 1980. Cost per hour of express service increased from $14.19 to $25.26, an increase of 78 percent, and cost per passenger increased from $.50 to $.85, an increase of 70 percent. At the same time, revenue/passenger increased very little, from $.44 to $.53, an increase of only 18 percent. Consequently, the operating ratio for commuter services (revenue/costs) went from .875 in 1975 to .61 in 1980, and the deficit per passenger increased fivefold, from

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[1] Status Report on the Three-Point Program, ConnDOT. Bureau of Planning and Research, June 1978, p. 21.

[2] The Clinton route has not been included in this report because patronage and cost data were not available.

TABLE V-9

CONNECTICUT COMMUTER PARKING PROGRAM

Route	Express Bus User Characteristics: Age (% under) 35	Sex % Female	Income (% over $15,000/yr.)	Major Reason for Use - In order of Importance (% citing as major factor): Reduce Trip Costs	Dislike Traffic Congestion	Dislike CBD Parking	High Cost of CBD Parking	Has Express Bus helped user to: (% "Yes"): Sell Second Car	Decide About Buying Another Car	Find Employ-ment	% Responding To Survey
Hartford Services											
Avon/Canton	43%	49%	76%	61%	63%	33%	39%	5%	5%	9%	260/301=86%
Corbins's Corner (W. Hartford)	58%	62%	60%	55%	60%	43%	57%	3%	8%	13%	304/336=90%
Glastonbury (St. Dunstan's)	40%	50%	64%	73%	51%	35%	43%	6%	21%	14%	64/68=94%
Glastonbury (St. Paul's/ St. Augustine)	34%	55%	56%	63%	54%	35%	44%	3%	13%	12%	164/196=84%
Burr Corners (Manchester)	58%	76%	76%	40%	58%	61%	48%	2%	9%	13%	462/537=86%
Old Saybrook (to Hartford)	44%	56%	87%	28%	53%	66%	28%	11%	43%	25%	77/79=99%
Vernon	49%	55%	53%	69%	54%	26%	41%	3%	17%	13%	275/300=92%
Colchester/ Marlborough	-	-	-	57%	52%	32%	35%	-	-	-	65/107=62%
Enfield	54%	41%	50%	72%	66%	27%	38%	4%	17%	19%	429/531=81%
Bristol	46%	60%	74%	65%	31%	34%	36%	5%	19%	18%	141/149=95%
Willimantic	60%	54%	64%	70%	56%	31%	21%	5%	20%	16%	82/87=94%
New Haven Services											
Branford		-	-	51%	66%	46%	57%	3%	9%	13%	253/325=78%
Milford	38%	53%	91%	67%	62%	42%	38%	-	16%	8%	88/90=97%
Old Saybrook	43%	47%	88%	75%	52%	-	54%	4%	20%	12%	121/139=87%
Totals											
Percent	44%	50%	58.6%	59%	58%	38%	44%	3%	13%	14%	
Number	1238	1391	1634	1647	1618	1064	1227	97	382	-	2785

TABLE V-10
MONTHLY COMMUTER COST - AUTO AND BUS

Cost Per Mile*	Milford (Zone 2)	Enfield (Zone 3)	Clinton (Zone 4)	Old Saybrook to New Haven (Zone 5)
Automobile				
Sub-compact $.25	$ 85.00	$190.00	$225.00	$320.00
Intermediate $.33	112.20	250.80	297.00	422.40
Standard $.36	122.40	273.60	324.00	460.80
Monthly Bus Pass**	30.00	40.00	50.00	60.00
Bus Cost Per Mile, Cents	8.8	5.2	5.4	4.6

*The cost per mile estimates were developed from the Hertz Corporation. Based on: 20 round trips per month, round trip Milford 17, Enfield 38, Clinton 45, Old Saybrook 64.

**After fare increase, March 1, 1980.

SOURCE: Connecticut Department of Transportation, Bureau of Planning & Research, Effects of Statewide Bus Fare Increase on Energy Conservation, and Economic, Environmental, and Social Impact, January 1980, p.13.

TABLE V-11

CONNECTICUT COMMUTER PARKING LOT PROGRAM
COMMUTER EXPRESS BUS SERVICES - COST DATA 1975-1980

Year	(1) Avg. (Daily) Bus Hrs:Min.	(2) Cost/Hr.	(3) Cost/Day	(4) Pass Bus/Hr.	(5) Pass/Year	(6) Pass/Day	(7) Cost/ Pass	(8) Operating Ratio (R/C)	(9) Deficit/ Pass	(10) Revenue/ Pass
1975	163:40	$14.19	$3,222	28.1	1,151,232	4,605	$0.50	0.87	$0.06	$0.44
1976	210:36	$15.53	$3,269	26.5	1,396,393	5,585	$0.58	0.78	$0.12	$0.45
1977	226:31	$15.52	$3,515	30.7	1,736,775	6,947	$0.51	0.84	$0.08	$0.42
1978	324:12	$20.78	$6,735	25.1	2,034,989	8,140	$0.82	0.63	$0.30	$0.53
1980	417:40	$25.26	$10,105	27.8	2,773,000	11,092	$0.85	0.61	$0.33	$0.52

SOURCE: "Economic Analysis of Commuter Bus Operations," ConnDOT, J.J. Spalding, 1979.

$.06 to $.33. Clearly, the financial position of commuter services has deteriorated greatly since 1974, despite an enormous increase in ridership. Table V-12 shows the most recent operational and cost figures for Connecticut's express buses.

The other side of the worsening financial condition results from insufficient growth in revenue per passenger. While revenues increased by 98 percent between 1974 and 1978, and ridership more than doubled, revenue/passenger increased only 20 percent during the 1975-1978 period, and barely increased at all from 1978 to 1980.

These findings indicate that in choosing sites for commuter express bus lots, locations should be selected by considering travel time or distance to the CBD, as well as travel demand as measured by trip volume or population density. The Park and Ride Planning Manual suggests that "in most instances, keeping bus travel times under 30 minutes seems to be a reasonable guideline." On the basis of travel surveys, ConnDOT has determined that commuters using the lots have a statewide average trip length (origin to destination) of 39.15 minutes, with most trips in the 20 to 60 minute range, with only 9 percent of these work trips using commuter lots under 20 minutes and 90 percent under one hour.[1] The PARKLOT program used to identify potential lot locations considers trip length and volume criteria, and the most successful park and ride facilities in Connecticut are located no more than 10 to 15 miles from the Hartford or New Haven CBDs, with an average bus travel time of about 27 minues.

C. Analysis of Regional Commuter Lot Utilization Patterns

1. Carpool and Express Bus Facilities with the Largest Increase in Utilization Between 1977 and 1980

The increase in lot utilization between 1977 and 1980 has been strongest in exurban regions, (especially Housatonic Valley and Litchfield Hills), and weaker in urbanized regions such as the Capitol, Southwestern, and Greater Bridgeport.

The disparity in these usage patterns can be explained by two factors. First, these has been a greater expansion of lot capacity (in percentage terms) in more remote areas. Even relatively modest increases in capacity appear large when compared to the small number of existing spaces. Lot capacity in these less densely populated areas increased more rapidly than in urbanized areas, where many of the best lot locations had already been developed by 1977. Second, these remote regions

[1] PARKLOT, ConnDOT Bureau of Planning and Research, 1976, p. 34.

TABLE V-12
CONNECTICUT COMMUTER PARKING LOT PROGRAM
EXPRESS BUS OPERATIONS DATA (as of January 1980)

Route	Route Length (one-way)	Est. Daily Bus-Miles (% Total)	Bus-Hours (% Total)	Passengers (% Total)	Passengers Per Bus-Mile	Passengers Per Bus-Hours	($) Cost Per Bus-Hour	($) Revenue (Cost) Per Passenger	Revenue/Cost Ratio
HARTFORD SERVICES									
Avon/Canton	15.1	576 (8.9%)	34.08 (9.5)	835 (7.9)	1.45	24.6	$25.73	$ .43 (1.05)	0.41
Barkhamsted-Torrington	25.9	198 (3.0%)	15.50 (4.3)	259 (2.4)	1.27 1.41	16.7	24.00	.89 (1.44)	0.62
Bristol	14.4	201.6 (3.1%)	20.50 (5.7)	572 (5.4)	2.84	27.9	24.00	.66 (.86)	0.77
Burr Corners	7.4	522 (8.0%)	28.42 (7.9)	1,264 (11.9)	2.42	44.5	25.73	.44 (.58)	0.76
Century Hills	11.7	217 (3.3%)	8.92 (2.5)	245 (2.3)	1.13	27.5	25.73	.44 (.94)	0.47
Corbins Corners	6.7	320 (4.9%)	17.83 (5.0)	988 (9.3)	3.09	55.4	25.73	.42 (.46)	0.91
Enfield	19.0	1,103 (17.0%)	49.80 (13.9)	1,700 (16.0)	1.54	34.0	25.73	.44 (.75)	0.59
Glastonbury-St. Augustine's	8.9	178 (2.7%)	10.00 (2.8)	464 (4.4)	2.42	46.4	25.73	.44 (.55)	0.80
Marlborough-Colchester	25.8	397 (6.1%)	16.25 (4.5)	373 (3.5)	.94	22.9	25.73	.76 (1.12)	0.68
Middletown	19.5	479 (7.4%)	17.72 (5.0)	597 (5.6)	1.24	33.7	25.73	.44 (.76)	0.58
Newington	9.2	227 (3.5%)	11.50 (3.2)	415 (3.9)	1.83	36.0	25.73	.44 (.71)	0.62
Old Saybrook	41	165 (2.5%)	18.00 (5.0)	218 (2.1)	1.32	12.1	26.31	1.30 (2.17)	0.60
Simsbury	19	585 (9.0%)	34.02 (9.5)	841 (7.9)	1.44	24.7	25.73	.44 (1.04)	0.42
St. Dustan's	12.4	87 (1.3%)	4.17 (1.2)	116 (1.1)	1.33	27.8	25.73	.44 (.92)	0.48
Unionville	14	186 (2.8%)	9.47 (2.6)	227 (2.1)	1.22	24.0	25.73	.44 (1.07)	0.41
Vernon	13.1	196.5 (3.0%)	20.00 (5.6)	707 (6.7)	3.59	35.3	22.50	.72 (.64)	1.13
Willimantic (Windham)	25.8	417 (6.4%)	19.28 (5.4)	345 (3.3)	.83	17.9	25.73	.89 (1.44)	0.62
Windsor Locks	12.8	438 (6.7%)	22.08 (6.2)	447 (4.2)	1.02	20.2	25.73	.44 (1.27)	0.35
TOTAL	61.4	6,493.1 (85.8%)	357.54 (89.4)	10,608 (100.0)	1.63	29.6	25.40	.52 (.86)	0.60

TABLE V-12
CONNECTICUT COMMUTER PARKING LOT PROGRAM
EXPRESS BUS OPERATIONS DATA (as of January 1980)
(continued)

Route	Route Length (one-way)	Est. Daily Bus-Miles (% Total)	Bus-Hours (% Total)	Passengers (% Total)	Passengers Per Bus-Mile	Passengers Per Bus-Hours	($) Cost Per Bus-Hour	($) Revenue (Cost) Per Passenger	Revenue/Cost Ratio
NEW HAVEN SERVICES									
Bronford	6.8	389 (36.2)	20.6 (41.3)	844 (65.0)	2.16	40.9	24.07	.44 (.59)	0.75
Milford	8.5	106 (9.8)	8.75 (17.9)	258 (19.9)	2.43	29.5	24.07	.44 (.81)	0.54
Old Saybrook	32	579 (53.9)	13 (40.8)	197 (15.1)	.34	15.1	24.07	.88 (1.59)	0.55
TOTAL		1,074 (14.1%)	42.35 (100.0)	1,299 (100.0)		30.7	24.07	.51 (.79)	0.61
OVERALL TOTAL		7,567.1*	399.89	11,907	1.57	29.77	25.26	.52 (.85)	0.61

*Bloomfield-Hartford route, started in June, 1980, increased total bus miles/day by 253.2, for a total of 7,820.3.

experienced considerable population and employment growth during the 1970-1980 period (see Census data included in Table V-13), while population in urbanized areas increased only slightly or declined.

Lot utilization data also reveals that exurban Capital region and Southwestern suburban lots experienced relatively large increases in utilization (92 percent, on average) between 1977 and 1980 (see Table V-14). These areas experienced neat commuter population growth.

2. Comparative Utilization of Carpool and Express Bus Parking Facilities

On an overall basis, relative utilization of carpool and bus lots appears basically proportional to capacity. In 1980, 57.6 percent of total parked cars occupied lots with bus service, which represented 56.8 percent of total capacity, while 42.3 percent of parked cars occupied carpool lots, which accounted for 43 percent of capacity. On average, carpool lots were 74.4 percent occupied, while bus lots were 76.9 percent occupied, indicating that carpool and express bus parking facilities are utilized roughly to the same extent overall. In general, carpool lot usage tends to increase with distance from the CBD, while park and ride express bus usage usually decreases with distance from the CBD.

Carpool lot usage seems correlated with trip length; carpooling is more prevalent than express bus use for trips over 12 to 15 miles. In general, locations beyond this distance lack sufficient population density to support express bus service, although several express bus routes over 20 miles have been successful. The carpool share of work trips tends to increase with trip length and usually declines as distance to the CBD decreases, for two reasons. First, as indicated by the original interchange parking survey in 1969 and subsequent surveys in other locations, reduction of travel cost is by far the more important to carpoolers than avoiding traffic congestion or downtown parking costs, which are major incentives for use of park and ride services. The greatest potential for cost savings occurs on long trips where out of pocket cost (especially for gasoline) are highest. Consequently, carpooling is more attractive in areas where work trips are relatively long, as a means of reducing travel costs.

The carpool share of work trips also tends to decreases with trip length if (as in Connecticut) suburban areas close to CBD destinations have adequate local and express bus service. Availability of bus service is definitely a factor in carpool lot utilization; in areas where bus service is provided, carpool lots usually are not as full as in areas where no bus service is provided. Lot utilization data from Connecticut

TABLE V-13
CONNECTICUT COMMUTER PARKING LOT PROGRAM
POPULATION OF PLANNING REGIONS[a]

Region	1960[b]	1970[b]	1977[c]	% Increase 1960-1970	% Increase 1970-1977
Capitol	546,545	669,900	684,272	23	2
Central Connecticut	186,667	215,200	217,700	15	1
Cenntral Naugatuck	195,512	223,200	243,900	14	9
Connecticut River Estuary	26,733	43,000	48,400	61	12
Greater Bridgeport	278,131	311,100	312,497	12	0.5
Housatonic Valley	87,280	136,500	158,408	56	16
Litchfield Hills	60,688	68,200	71,715	12	5
Mid-State	66,383	78,400	83,711	18	7
Northeastern	47,436	59,000	65,430	24	11
Northwestern	15,928	18,400	19,980	16	9
South Central	448,835	507,800	517,310	13	2
South Eastern	179,060	220,400	233,698	23	6
South Western	279,204	333,900	349,458	20	5
Valley	60,241	73,700	76,710	22	4
Windham	48,732	64,400	67,578	32	5
Non-Defined[d]	7,859	9,100	10,650	16	17
TOTAL	2,535,234	3,032,200	3,161,417	20	4

[a]Includes institutional populations.
[b]Source: U.S. Census of Population, 1960 and 1970.
[c]Source: Connecticut Department of Health, 1977 estimates.
[d]Includes Towns of Stafford and Union.

TABLE V-14

CONNECTICUT COMMUTER PARKING PROGRAM
STRONG UPWARD USAGE TRENDS AT COMMUTER LOTS, 1977-1981

Lot No.	RPA	Location	1980 Capacity	Occupancy 1977-1980 1977	1978	1979	1980
401	2	Danbury Route 7	34	8	10	36	72
321	6	Shelton Route 8	100	20	96	84	108
308	7	Fairfield Routes 15 & 59	210	42	186	162	168
322	7	Stratford Routes 15 & 110	80	60	72	62	80
301B	8	Branford Route 1	328	168	168	248	264
302B	8	Milford I-95 Old Gate	74	36	64	52	88
303B	8	Guilford I-95 & Rt. 77	112	68	108	120	130
327	8	Wallingford Route 5	24	16	14	36	40
114B	10	Simsbury Route 10	30	24	24	66	36
121B	10	Vernon Route 31	248	96	120	136	192
122B	10	Vernon Route 30	198	96	144	138	246
111B	11	Middletown Route 9	90	66	-	108	96
214	13	Norwich Route 52W	112	100	88	144	176
216	13	Norwich Routes 52 & 97	60	52	54	78	80
228	13	Groton I-95 & CT 117	50	38	60	54	40

B = Served by Express Bus.

supports this conclusion; carpool lots in regional planning areas where express bus service is provided, especially in the Capitol (Hartford) and South Central (New Haven) regions tend to be substantially less occupied than carpool lots in areas where there is no bus service.

As noted earlier, the shorter express bus routes tend to be the most heavily utilized, the most productive (in terms of passenger/bus-mile or bus-hour), and the most cost-effective (as measured by share of costs covered by revenues). Short distance express runs are more heavily utilized because of greater travel demand associated with more densely populated areas near the CBD, and because these areas are most affected by rush-hour traffic congeston.

Occupancy data for commuter parking lots in Connecticut provides further evidence of the importance of trip length, or travel distance, on the relative utilization of carpool and express bus facilities. Although not all regional planning areas have both carpool and express bus lots, in regions corresponding to densely populated urbanized areas of the State, express bus lots are usually occupied to a greater extent than express bus lots in more remote areas, over 20 miles from any downtown destination. Conversely, although many carpool lots (usually small ones) in remote areas of the State at least 20 miles from any major city are filled to capacity on a regular basis, the few large carpool lots in urbanized areas are chronically underutilized.

Comparison of the percentage of carpool and bus lot capacity in each regional planning area with the percentage of parked vehicles in area lots allows identification of some other utilization trends.

For example, Region 2 (Housatonic Valley) has only 6 percent of its total spaces in carpool lots but 10 percent of parked vehicles assumed to be used for carpooling (or 2.5 percent of total spaces and 5.0 percent of total parked cars), indicating that use exceeds capacity in this area. Lots in this exurban region are heavily used for carpooling. There is little transit service and much commuting to dispersed corporate park work sites.

In the Capitol region (RPA #10), the relatively low utilization of carpool lots can be attributed to the provision of bus service to downtown Hartford from nearly all commuter lots. Greater use of express buses in this urbanized region is not surprising, given the relatively short average work trip length (6.6 miles, one-way), severe traffic congestion, and the high concentration of employment downtown. However, Region 4 (Litchfield Hills) displays an opposite trend with bus lots relatively underutilized (40.9 percent occupied), indicating a greater dispersion of employment sites and work trips in this region, with relatively few trips to downtown Hartford. High utilization of carpool lots in this region can also be attributed to rapid employment and population growth, as much residential and employment growth has occurred in this area over the past ten years.

Carpooling and park and ride facilities do not necessarily compete with one another with overcapacity as the result. In RPA #8 (South Central, including New Haven), both carpool and park and ride facilities are well utilized. In fact, park and ride and carpool lots ideally should serve different segments of commute travel demand; carpool lot facilities tend to be more utilzed in low-density areas at least 15 to 20 miles from any major city, while park and ride services are more successful for routes under 10 to 12 miles in length.

IV. PROGRAM IMPACTS

A. Project Monitoring Methods

ConnDOT has used several methods to keep track of commuter lot and express bus utilization trends, and to identify the characteristics of facility users and their work trips. Express bus patron surveys are performed at least once every 2-3 years for each express bus route. These surveys provide data on express bus patronage, user characteristics (age, sex, income), as well as mode of access, trip origin and destination, trip purpose and frequency, the mode formerly used to make the trip, and reasons for use of the service. ConnDOT also keeps daily and weekly records of express bus ridership, and monthly records of commuter parking lot occupancy.

In 1976-77, ConnDOT conducted a Statewide Household Travel Survey in order to determine travel characteristics of Connecticut households and to collect data needed to develop a person trip travel forecasting procedure to be used for evaluating transportation improvement alternatives. The survey, which was based on a 3 percent sample of households in the State, collected data on typical weekday travel behavior, including trip origin and destination, trip purpose, modal choice, income, and availability of an auto or transit service. While the survey was not directed solely at commuter lot users, it produced much information on trip length and modal choice for work trips in different areas of the State, which is useful in examining the impacts of the commuter parking lot program.

B. Impact on Travel Behavior

1. Trip Characteristics

For lots served by express buses, the average home to lot trip is 6.23 minutes, and the average trip from lot to destination is 33.39 minutes, for a total travel time of about 40 (39.62) minutes. Most home-to-lot trips are less than 10 minutes.[1] The home-to-lot trip accounts for about 20 percent of the total trip length, which is consistent with results found by Barton-Aschman in 1970.[2] Average total trip time of 40 minutes corresponds well with Gatens' assessment of 40 minutes (including a five mile trip from origin to lot, waiting for the bus, and a 25 minute trip to the CBD) as the maximum allowable total trip time for park and ride services.[3] While this breakdown of travel time segments seems accurate for many

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[1] Statewide Household Travel Survey, 1977.

[2] Commuter Parking at Highway Interchanges, Barton-Aschman Associates, Chicago, 1970 (Bureau of Public Roads).

[3] Locating and Operating Bus Rapid Transit Park and Ride Lots, D. Gatens, ITE.

express bus trips in Connecticut, users of a few services (such as Old Saybrook - Hartford and Barkhamsted - Hartford) appear willing to accept travel times of an hour or more from lot to CBD.

Table V-15 presents the modes of access used by express bus users. The majority of users (over 60 percent) drive alone to the lot; while this percentage is high compared to some other park and ride operations, the percentage who carpool to the lots (about 12%) is higher than at many such facilities, and the percentage who arrive as passengers (kiss and ride, etc., about 20 percent), is lower.[1]

It is not clear why carpooling to express bus lots occurs as frequently as seems the case, but this may be evidence of strong efforts made by private employers to encourage carpooling and transit use, particularly in the Hartford area. Major employers, including United Technologies and Connecticut General, have sponsored private express bus transportation at certain commuter lots. Others have encouraged express bus ridership by partially subsidizing express bus passes or promoted ridesharing through participation in nonprofit ridesharing assistance organizations, such as the Hartford Ridesharing Corporation or Metropool in Stamford.

2. Modal Diversion

Express bus survey data indicate that a significant number of riders formerly made the trip in a single occupant auto. Table V-16 presents a breakdown of how express bus users formerly made the trip. From 31 percent to 71 percent of the riders formerly drove alone, with smaller percentages being diverted from local buses (2 to 13 percent), carpools (7 to 39 percent), and other autos (5 to 15 percent). The percentage diverted from single occupant auto trips is above average, and diversion rates from other modes are normal, based on prior mode data from other U.S. locations.[2]

Table V-17 presents work trip data for the regional planning areas in Connecticut, indicating that of the 444,983 daily work trips (two-way) made in Connecticut, only 9,992 (or 2.24 percent) were made using park and ride facilities. While many work trips are suburb to suburb or otherwise poorly suited to park and ride operations, the percentage of park and ride commuter trips is small, even in the areas where the most facilities and service are provided (RPA #10, Hartford, 4.02 percent, and RPA #8, New Haven, 4.42 percent). These two areas have the bulk of the service and facilities because ConnDOT has

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[1]Exhibit 4-3, Park and Ride Manual, November 1978, p. 13.
[2]Exhibit 6-1, Park and Ride Manual, NJDOT, November 1978, p. 25.

TABLE V-15

CONNECTICUT COMMUTER PARKING LOT PROGRAM
EXPRESS BUS USER TRAVEL CHARACTERISTICS
MODE OF ACCESS TO LOT

Route	Percent Of Users Making Trip To Work	Drove Alone (SOA)	Auto Passenger	Carpool	"Other" Bus or Walk	Percent Using Monthly Passes	Percent Of Pass Users Subsidized By Employer	Percent Rating Bus Service "Good or Better"	Total Respondents
Hartford Services									
Avon/Canton	98%	63%	19%	11%	7%	60%	-	90%	260
Corbin's Corner (West Hartford)	99%	68%	16%	11%	2%	56%	-	67%	304
Glastonbury (St. Dunstan's)	100%	50%	16%	23%	9%	72%	85%	76%	64
Glastonbury (St. Paul's & St. Augustine Lines)	98%	62%	13%	6%	19%	63%	77%	79%	164
Burr Corners (Manchester)	99%	74%	12%	10%	-	78%	-	85%	462
Old Saybrook (To Hartford)	99%	52%	13%	17%	7%	45%	-	79%	77
Vernon	99%	69%	16%	11%	Walked 4%	69%	75%	77%	275
Colchester/ Marlborough	97%	54%	20%	15%	8%	63%	-	-	65
Enfield	97%	62%	20%	15%	2%	71%	-	79%	429
Bristol	97%	55%	28%	11%	Walked 6%	61%	-	82%	141
Willimantic	99%	54%	30%	6%	10%	55%	-	70%	82
New Haven Services									
Branford	93%	68%	18%	8%	-	45%	-	94%	253
Milford	99%	75%	19%	6%	-	30%	100%	97%	88
Old Saybrook (To New Haven)	96%	69%	18%	6%	Walked 7%	53%	22%	85%	121
Totals	2721 98%	1821 65%	486 17%	303 11%	115 4%	1741 63%	501 18%	2221 80%	2785

TABLE V-16

CONNECTICUT COMMUTER PARKING PROGRAM

Route	Date Service Initiated	Date of Survey	Means of Making Trip to Work Prior to Using Express Bus: Single Occupant Auto	Auto Passenger	Carpool	Local Bus	Did Not Make Trip	Total Responses	No Response or "Other"	Patronage Growth: Riders on First Day	Survey Date
Hartford Services											
Avon/Canton	07/16/73	10/25/77	53%	9%	11%	1%	26%	246	-	81	301
Corbins's Corner (W. Hartford)	01/17/72	08/04/77	31%	11%	9%	10%	34%	289	5%	-	-
Glastonbury (St. Dunstan's)	04/14/75	02/19/80	53%	-	19%	4%	17%	59	8%	18	68
Glastonbury (St. Paul's/ St. Augustine)	09/17/73	02/26/80	50%	4%	7%	12%	24%	159	3%	-	196
Burr Corners (Manchester)	07/10/72	05/08/80	34%	8%	13%	13%	32%	436	-	76	525
Old Saybrook (to Hartford)	10/24/77	05/18/78	38%	7%	10%	4%	40%	76	1%	64	77
Vernon	07/11/77	05/06/80	35%	7%	17%	9%	27%	262	5%	216	300
Colchester/ Marlborough	06/28/76	06/01/77	41%	15%	28%	6%	3%	61	7%	77	107
Enfield	01/21/74	08/25/77	33%	8%	19%	1%	28%	380	11%	176	531
Bristol	04/04/77	08/09/77	33%	10%	16%	18%	20%	137	3%	204	281
Willimantic	02/23/76	12/15/77	33%	-	39%	3%	25%	81	-	86	170
New Haven Services											
Branford	07/16/73	11/02/78	44%	9%	7%	10%	30%	241	-	98	700
Milford	09/23/74	12/20/79	53%	-	13%	6%	20%	78	8%	47	90
Old Saybrook	01/17/77	08/14/80	52%	5%	13%	8%	20%	116	2%	73	288
Totals			40%	8%	14%	7%	27%	2621	108 (4%)	1216	3634

TABLE V-17
CONNECTICUT PARKING PROGRAM
EXPRESS BUS AND CARPOOL SHARE OF DAILY WORK TRIPS (SEPTEMBER, 1980)

Regional Planning Area (RPA)	Use (Daily)	Work Trips	% of Market[1]
1	238	45,319	$\frac{1.28 \times 238}{45,319}$ = .0067 = 0.67%
2	372	25,735	$\frac{1.28 \times 372}{25,735}$ = .0185 = 1.85%
3	-	-	-
4	224	14,465	$\frac{1.28 \times 224}{14,465}$ = .0198 = 1.98%
5	368	31,178	$\frac{1.28 \times 368}{31,178}$ = .0151 = 1.51%
6	136	17,818	$\frac{1.28 \times 136}{17,818}$ = .0098 = 0.98%
7	460	30,870	$\frac{1.28 \times 460}{30,870}$ = .0191 = 1.91%
8	1,370	71,327	$\frac{1.28 \times 1,370}{71,327}$ = .0246 = 2.46%
9	256	33,020	$\frac{1.28 \times 256}{33,020}$ = .0099 = 0.99%
10	3,026	93,040	$\frac{1.20 \times 3,026}{93,040}$ = .0416 = 4.16%
11	236	12,908	$\frac{1.28 \times 236}{12,908}$ = .0234 = 2.34%
12	266	6,082	$\frac{1.28 \times 266}{6,082}$ = .0560 = 5.60%
13	723	36,346	$\frac{1.28 \times 723}{36,346}$ = .0255 = 2.55%
14	148	12,895	$\frac{1.28 \times 148}{12,895}$ = .0147 = 1.47%
15	54	7,672	$\frac{1.28 \times 54}{7,672}$ = .0090 = 0.90%
16	4	3,063	$\frac{1.28 \times 4}{3,063}$ = .0017 = 0.17%
TOTAL	7,881	444,983	

STATEWIDE TOTAL $\frac{1.28 \times 7,881}{444,983}$ = .0227 = 2.27%

About 2.27% of daily work trips statewide make use of carpool or express bus commuter parking facilities.

[1]Assumes vehicle occupancy = 1.28

determined that Hartford and New Haven are destinations for substantial numbers of suburb to CBD oriented work trips.

The parking lot program overall has had little effect on modal usage statewide; about 2.5 percent of all trips in Connecticut were made by bus in 1970 and in 1980.[1] Moreover, in the Hartford SMSA, which is the focus of many commuter lot facilities and most of the express bus routes, transit's share of work trips declined from 10.7 percent in 1970 to 7 percent in 1975, a decline of 3.7 percent.[2] VMT statewide and in the Hartford and New Haven metropolitan areas have also increased between 1975 and 1980, despite reductions attributable to the program. This is not surprising, since 71 percent of workers in the Hartford SMSA still drive to work alone.[3]

The carpool/park-and-ride lot program has had little impact on modal shift or reducing vehicle-miles traveled (VMT) because the vast majority of work trips are local, relatively short (under 10 miles one-way), and have widely dispersed destinations in suburban areas. The slight modal shift attributable to the program is a result of this decentralized travel pattern rather than any shortcomings of the program itself.

3. Carpooling and the Commuter Lot Program

Unfortunately, very little information is available about carpooling behavior at commuter parking lots. This is because most carpools, even many of those started as a result of employer-sponsored ridesharing matching programs, tend to be informal, temporary arrangements among co-workers which last an average of six to twelve months.[4] The size, composition and number of carpools is extremely variable and changes almost continually, making it very difficult to collect accurate information about the number and size of carpools. For similar reasons, no attitudinal surveys of carpoolers have been conducted, in contrast to the extensive data from express bus rider surveys.

Although little data has been collected on the number of carpools using the lots or the number of carpools statewide, in 1981 ConnDOT conducted a limited survey of ridesharing at 85 corporations, mainly in the Hartford area. The survey found

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[1] Analysis of Alternative Transportation Control Measures, Capitol Region Council of Governments (Wilbur Smith & Associates), April 1981.

[2] 1975 Journey to Work Data, U.S. Bureau of the Census, U.S. Department of Commerce, Washington D.C., 1976.

[3] 1975 Journey to Work Data, U.S. Bureau of the Census, U.S. Department of Commerce, Washington D.C., 1976.

[4] The Survey also found 600 vanpools as of April 1981, up from 7 in 1976, mainly the result of corporate vanpooling programs.

that about 5,000 carpools, with an average occupancy of 3.1 persons and an average round-trip length of 42 miles, were active at these employment locations. The 1976 U.S. Census Journey to Work survey found that about 20 percent of daily work trips in the Hartford region (about 52,000 of 235,000 daily person trips) were made by carpool.[1]

It is safe to say that there has been a large increase in carpooling since 1971, lagging slightly behind lot expansion, as is indicated by the enormous increase in cars parked at carpool lots between 1971 (129) and 1980 (3,526). It appears that the parking lot program has been very important in stimulating this growth. However, it is very difficult to gauge the importance of the lot program in encouraging carpooling for two reasons. First, many employer-sponsored ridesharing programs have coincided with the development of the commuter parking lot program in the 1970s, and the effectiveness of these programs is difficult to measure. Second, expansion of the lot program occurred during a period marked by gasoline shortages and a large increase in the price of gasoline.

C. Reduction of Vehicle-Miles Traveled (VMT) Attributable To The Express Bus/Carpool Lot Program.

Table V-18 presents the VMT reductions attributable to use of the carpool lots and the express bus system. Estimates of VMT reductions ascribed to the carpool lot and express bus programs were derived separately, using different methods.

The first step in the calculations was a review of the most recent complete lot occupancy data, from counts taken in September 1980. Table V-19 shows lot occupancy statistics showing actual lot occupancy counts as well as the adjusted counts which allocate 10 percent of the vehicles in "bus" lots to carpools. The adjusted counts were used as the basis for computing the VMT reduction attributable to carpools using the lots.

The total VMT reduction attributable to the entire carpool/express bus lot program in 1980 was 194,612. This represents a reduction of about .45 percent of VMT statewide (estimated at 43,320,600/day), and about 1.04 percent of work trip VMT (estimated at 18,632,158 per day).

D. Program Impact On Energy Consumptiom

Estimation of reductions in gasoline consumption associated with the commuter car pool/express bus program were based on estimates of stable and transition VMT derived in

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y1Journey to Work Survey, 1975-76, U.S. Dept. of Commerce, Bureau of the Census.

TABLE V-18
CONNECTICUT COMMUTER PARKING LOT PROGRAM
REDUCTION IN VEHICLE-MILES TRAVELED (VMT)

Regional Planning Area (RPA)	Percent of Work Trips	Average Work Trip Length (2-way)	Carpool Lots	%	Park and Ride Lots	%	Total	%
1. Southwestern	10.2%	13.8	1,615,750	5.9			1,615,750	3.3
2. Housatonic Valley	5.8%	20.6	2,625,250	9.6			2,625,250	5.4
3. Northwestern	.77%	16.1						
4. Litchfield Hills	3.25%	15.5	572,000	2.9	1,201,000	5.7	1,773,000	3.6
5. Central Naugatuck	7.0%	16.0	2,540,500	9.3			2,540,500	5.2
6. Valley	4.0%	13.5	903,000	3.3			903,000	1.9
7. Greater Bridgeport	6.9%	14.4	3,215,000	11.7			3,215,000	6.6
8. South Central	16.0%	13.3	5,806,500	21.2	2,316,750	10.9	8,123,250	16.7
9. Central	4.4%	14.1	311,500	1.1	1,176,000	5.5	1,487,500	3.1
10. Capitol	20.9%	13.2	3,084,000	11.2	11,199,500	52.8	14,283,500	29.4
11. Midstate	2.9%	16.0	239,500	0.9	1,185,500	5.6	1,425,000	2.9
12. Connecticut River	1.36%	17.5	296,000	1.0	2,491,500	11.7	2,887,500	5.7
13. Southwestern Conn.	8.8%	15.5	5,151,000	18.8	679,000	3.2	5,830,000	12.0
14. Windham	2.9%	21.4	587,000	2.1	977,5000	4.6	1,564,500	3.2
15. Northeast	1.7%	15.2	447,500	1.6			447,500	0.9
16. Undefined Towns	.68%	18.9	31,750	0.1			31,750	0.1
Total			27,426,250		21,226,750		48,653,000	
Daily Total			109,705		84,907		194,612	

Daily VMT reduction is .45% of 1980 Daily VMT statewide (average)(43,330,600) and 1.04% of Daily VMT associated with work travel (18,632,158)

TABLE V-19
CONNECTICUT COMMUTER PARKING PROGRAM
COMMUTER PARKING LOT CAPACITY AND USE (as of September 1980)

RPA	Number of Lots Carpool	Number of Lots Bus	Capacity Carpool	Capacity Bus	Occupancy Carpool	Occupancy Bus	Use Rate Carpool	Use Rate Bus	Total Spaces	Total Use Rate
1	6	0	320	0	238	0	74.4%	-	320	74.4%
2	3	0	266	0	372	0	14.0%	-	266	14.0%
3	-	-	-	-	-	-	-	-	-	-
4	6	3	92	328	76	148	82.6%	35.2%	420	43.7%
					(90)*	(134)				
5	10	0	405	0	368	0	92.0%	-	405	92.0%
6	2	0	181	0	136	0	75.1%	-	181	75.1%
7	8	0	650	0	460	0	70.7%	-	650	70.7%
8	19	4	1,011	631	762	608	75.3%	37.0%	1,642	51.6%
					(823)	(547)				
9	1	1	30	268	22	234	73.3%	78.5%	298	78.0%
					(46)	(210)				
10	7	22	285	3,777	138	2,888	48.4%	71.1%	4,062	69.6%
					(428)	(2,598)				
11	1	2	12	195	12	224	100.0%	114.0%	207	114.0%
					(35)	(201)				
12	1	5	35	275	12	254	34.2%	92.7%	310	86.0%
					(56)	(210)				
13	15	1	899	225	645	78	71.7%	34.6%	1,124	64.3%
					(653)	(70)				
14	4	2	200	205	42	106	21.0%	51.9%	405	36.6%
					(53)	(95)				
15	1	0	86	-	54	0	62.7%	-	86	62.7%
16	1	-	20	-	4	0	20.0%	-	20	20.0%
	85	40	4,493	5.903	3,341	4,540	74.4%	76.9%	10,396	75.8%
					(3,816)	(4,065)				

*Numbers in parentheses include allocation of 10% of parked cars in lots served by express bus to carpools (based on observations of parking behavior).

sections IV.C and IV.D. Since "cold start" engines in the transition phase consume more gasoline per mile than "warm" engines in the stable phase, reductions in transition VMT save more gasoline per mile than reductions in stable VMT. Consequently, fuel savings were estimated by dividing stable and transition VMT reductions by separate fuel economy averages derived from the results of a recent FHWA report.[1] These factors, which vary with average travel speed, are about 19 miles per gallon for stable phase travel and about 17 miles per gallon for transition phase travel.

Total gasoline savings attributable to the entire carpool/ express bus program were estimated at 2,632,532 gallons in 1980. About 53.3 percent of this reduction, or 1,404,000 gallons was associated with the carpool lot program, and 1,228,532 gallons, or 46.7 percent, with the express bus program. However, these reductions do not take the bus-miles for express bus operations into account. With yearly express bus mileage estimated a 1,955,075 miles, and bus fuel economy (in gasoline equivalents of diesel fuel) of 3.67 miles per gallon, about 532,718 gallons of gasoline are used each year by buses serving park and ride lots. In addition, bus maintenance requires roughly .105 gallons/vehicle mile, or about 205,365 gallons/ year.[2] If these quantities, a total of 738,038 gallons, are subtracted from the gross gasoline savings associated with park and ride services, the net total from the express bus program is reduced to 490,449 gallons/year, for an overall total of 1,894,449 gallons/year. This represents .14 percent of total yearly gasoline consumption in Connecticut, estimated at 1,320,000 gallons in 1980, or about .48 percent of gasoline consumed in home to work travel.

E. Economic Impacts

1. Leased Shopping Center Lots - The "Spillover" Problem

One of the recurrent issues which has arisen in Connecticut and other areas where commuter parking spaces have been leased from commercial properties concerns the alleged "spillover" of parking by commuters into non-leased spaces retained by shopping centers. ConnDOT's view is that such "spillover" is not a serious problem anywhere, although management of some shopping centers (notably Enfield Mall, which threatened to terminate its license agreement with ConnDOT) feel otherwise. A review of parking lot occupancy data over the period June 1979 -

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[1]"A Method For Estimating Fuel Consumption and Vehicle Emissions on Urban Arterials and Networks," FHWA Office of Research and Development, April 1981.

[2]Energy Impacts of Transportation System Management Actions in New York State, 1978-1980, Planning Research Unit, New York DOT, May 1979.

January 1981 for locations where license agreements are in effect indicates that "spillover" has been a significant problem at only two lots - Corbin's Corner, where the commuter lot was substantially over capacity between July 1979 and March 1980, and at Avon, where the leased lot has been at or near capacity since 1978. Two other lots, Bristol and Enfield Mall, have been approaching capacity (over 80 percent full) during the past year. None of the other leased lots is anywhere near capacity, and recent data (January, 1981) indicates that none of the lots is over capacity. This tabulation assumes that commuter vehicles park in the designated areas, which may not always be the case, although ConnDOT attempts to mark the leased areas clearly, and uses personnel to direct commuters to the parking areas during the initial weeks of bus service at a new leased location. "Spillover" in the recent past can be attributed to unusually high bus patronage during the 1979 gasoline shortage; it has not been a problem since then, but could become a problem at several locations which are nearing capacity.

2. Impact on Shopping Centers - Shopper Surveys

In order to stress the benefits of license agreements to shopping centers and to counter criticisms, since 1977 ConnDOT's express bus surveys have included questions about commuter shopping behavior associated with the use of lots at shopping centers, to determine the extent of business generated by commuters. These questions have sought to determine:

1. The number of riders who began shopping at the facility since the initiation of bus service (as opposed to those who shopped there previously).

2. The approximate sum of money spect weekly at the shopping centers by express bus riders (under $10, $11-25, $26-35, over $35) per person.

3. The type of purchases made (groceries, clothing, pharmaceuticals, various items, etc.)

4. Whether the location of the lot has made shopping more convenient (yes or no).

A summary of responses to these survey questions at shopping center lots is presented in Table V-20. While no large increase in patronage at these shopping areas is attributable to the commuter lot program, the lots do generate a significant amount of sales which might not otherwise be made. According to survey responses over the 1977-1980 period, express bus patrons spent over $869,000 per year at shopping centers adjacent to leased commuter lots. About 26 percent of those responding to the shopping questions said that they had not shopped at

TABLE V-20
CONNECTICUT COMMUTER PARKING PROGRAM
SURVEY RESULTS - PARKING AREAS LEASED TO CONNDOT AT SHOPPING CENTERS

Service Name	Survey Date	Number of Responses to Shopping Questions	Patrons Annual Expenditure	(3) Number of Service - Attracted New Shoppers	New Shoppers' Annual Expenditure	Total Shopping Center Spaces	Total Leased For Commuters	% of Parking Leased	(4) Shopping More Convenient Yes
Avon/Canton	10/25/77	206	123,000	54	50,000	800	180	22.5	83%
Bristol	9/08/77	109	58,000	36	24,500	650	268	41.0	79%
West Hartford	8/04/77	260	225,000	77	70,000	1,900	275	14.0	91%
Enfield Mall(1)	8/25/77	363	120,000	77	39,000	2,200	504	22.9	81%
Enfield Bradlees(1)	8/25/77	-	90,000	20	23,000	1,180	230	19.0	81%
Torrington(2) (Star's Plaza)	12/14/78	39	33,000	6	5,000	622	132	21.0	72%
Torrington Caldor	-	-	-	-	-	1,600	96	6.0	-
Willimantic	12/15/78	35	14,600	7	2,600	500 est.	154	31.0	53%
Newington	9/18/80	160	206,000	35	56,000	-	-	-	-
		1,172	869,000	312 (26.6%)	270,100	9,452	1,839	19.4%	-

(1)This service operates from two shopping centers.
(2)This service operates from two shopping centers; totals are combined.
(3)The number of respondents who indicated that they were new shoppers at the center as a direct result of the commuter bus operation (i.e., did not shop there previously).
(4)Percent answering yes to the question "Do you feel that parking in this lot makes your shopping errands more convenient."

SOURCE: ConnDOT Bureau of Public Transportation these locations prior to initiation of express bus service. These "new" shoppers account for a total of $268,100 in sales yearly. Only a small percentage of respondents (about 15 percent) indicated that they did not shop at the stores adjacent to the leased lots, and the vast majority said that locating commuter parking lots in shopping centers made shopping more convenient. Most purchases made by respondents were for groceries or "various items", another indication that commuters found the location convenient for afterwork shopping, eliminating the need for an additional trip. Available evidence indicates that while "spillover" may be a problem at certain locations from time to time, most of the lots have sufficient excess capacity. On balance, the shopping centers derive significant benefits from commuter patronage and State rental payments.

F. Comparison of Carpool and Express Bus Programs - Impacts on Vehicle-Miles Traveled, Energy Consumption, and Vehicular Emissions

Comparison of impacts estimated for the carpool lot and park and ride lot programs provides evidence of the relative effectiveness of these strategies in reducing VMT, energy consumption, and vehicular emissions. Based on the calculation in Section IV.C, about 45 percent of the gross VMT reduction associated with the carpool lot program (i.e., the VMT reduction not adjusted for the carpool VMT), is offset by carpools making the trip from lot to destination. Gross fuel use and emissions reductions are lowered by roughly the same proportion (46 percent). The result of this compensation for carpool VMT is that emissions are reduced .037 pounds for each VMT saved by the carpool program, and fuel use is reduced by 12.8 gallons for each VMT saved (see Table V-21 and V-22). The net VMT savings for carpools are substantially below the gross reduction because each carpool (average size, 3.1 persons) replaces only two cars, and also because the trip from lot to destination is usually long (10 to 15 miles or more).

VMT reductions associated with the park and ride lots can also be adjusted to reflect the increase in emissions and fuel use connected with providing bus service.

Although the gross fuel use reduction credited to the park and ride program is 1,228,532 gallons/year, bus operations consume 738,038 gallons/year (in gasoline equivalents of diesel fuel), leaving a net savings of 490,449 gallons per year. Bus operations consume fuel equal to about 60 percent of the gross fuel reduction. The increase in emissions associated with bus service (about .47 tons/day) is about 27 percent of the gross emissions savings from the park and ride program. Adjustment of gross emissions and fuel use for bus mileage yields on emissions reduction of .031 pounds for each VMT saved by the park

TABLE V-21

CONNECTICUT COMMUTER PARKING PROGRAM
EMISSIONS REDUCTIONS (GRAMS/DAY)

	Total Nonmeth.	HC %	Evap.	HC %	Exhaust	CO %	Exhaust	NO_x %	
Southwestern	11,470	3.4	4,844	3.3	93,397	3.4	9,724	3.2	
Housatonic Valley	17,652	5.2	7,871	5.4	136,934	5.0	16,321	5.3	
Northwestern	-	-	-	-	-	-	-	-	
Litchfield Hills	12,611	3.7	5,315	3.6	102,489	3.8	10,668	3.5	
Central Naugatuck	17,082	5.1	7,617	5.2	132,514	4.9	15,794	5.2	
Valley	6,410	1.9	2,707	1.9	52,197	1.9	5,435	1.8	
Greater Bridgeport	21,618	6.4	9,639	6.6	167,696	6.1	19,987	6.5	
South Central	57,068	16.9	24,384	16.7	460,795	16.9	51,474	16.8	
Central	11,186	3.3	6,159	4.2	95,431	3.5	9,200	3.0	
Capitol	108,187	32.0	43,122	29.5	929,413	34.1	94,173	30.8	
Mid-State	10,010	3.0	4,268	2.9	80,492	3.0	9,014	2.9	
Conn. River	13,363	4.0	6,588	4.5	94,513	3.5	14,551	4.7	
Southwestern Conn.	37,534	11.1	17,469	12.0	278,392	10.2	37,005	12.1	
Windham	10,522	3.1	4,685	3.2	81,593	3.0	9,724	3.2	
Northeast	2,782	0.8	1,342	0.9	19,948	0.7	2,091	0.9	
Undefined Towns	204	0.1	95	0.1	1,516	0.1	202	0.1	
Total	337,699		146,105		2,727,320		306,173		
Tons/Day	.37		.16		3.00		.34		3.87 Tons/Day
Tons/Year	92.5		40.0		750		85		967.50 Tons/Year
- (Bus Emissions)	(9.8)		(0.0)		(64.1)		(44.5)		- (118.40) Tons/Year
NET REDUCTION	82.7		40.0		685.9		40.5		
					NET EMISSIONS REDUCTION =				849.10 Tons/Year

NOTE: Net Emissions Reduction is .076% of statewide total transportation-related emissions (1,219,819 tons), and .23% of work trip transportation-related emissions (358,479 tons).

TABLE V-22

CONNECTICUT COMMUTER PARKING PROGRAM
PROGRAM IMPACT ON ENERGY CONSUMPTION (1980)

RPA	Carpool Lots (Gallons)	Park & Ride Lots (Gallons)	Total Gallons Of Gasoline Conserved	% Of Total Gasoline Saved	% Of Total VMT Reduction
1	82,250	-	82,250	3.10	3.30
2	134,000	-	134,000	5.00	5.40
3	-	-	-	-	-
4	29,000	73,500	102,500	3.90	3.60
5	129,500	-	129,500	4.90	5.20
6	46,000	-	-	1.70	1.90
7	163,751	-	-	6.20	6.60
8	296,250	136,530	432,530	16.40	16.70
9	15,750	70,419	86,169	3.30	3.10
10	157,500	651,134	808,634	30.70	30.10
11	12,250	69,327	81,577	3.10	2.90
12	16,250	136,622	152,872	5.80	5.70
13	266,000	35,072	301,072	11.40	12.00
14	30,250	56,178	86,478	3.30	3.20
15	23,500	-	-	.89	.90
16	1,750	-	-	.06	.10
Total	1,404,000	1,228,532	2,632,532		

- (532,718) for bus operations
- (205,365) for bus maintenance
= 1,894,449 NET REDUCTION (Gallons/Year)
= .14% of total statewide gasoline consumption (estimated at 1,324,800,000 gallons in 1980)
= .48% of total gasoline consumed in home-to-work travel (about 388,240,000 gallons in 1980)

and ride program, and about 5.7 gallons of gasoline for each VMT reduced. The net reductions of VMT adjusted for bus mileage are lower than the gross reduction because buses consume considerably more fuel and emit substantially more pollutants per mile than autos.

Consequently, when VMT reductions are adjustd to reflect bus and carpool mileage, it appears that the carpool program produces slightly greater emissions reductions and considerably greater gasoline savings per VMT reduced. This is largely because of the high fuel consumption of buses (3.67 miles/gallon) emissions reduced per VMT are similar for both programs, and without the compensation for bus fuel consumed, the reduction of energy consumption for the park and ride program would be 14.4 gallons/VMT.

In fact, reductions in fuel use and emissions are less than proportional to VMT reductions for carpools, since the relatively long average access trip from home to the carpool lot (10.55 minutes) means that all VMT reductions occur during the stable phase of the trip, when fuel consumption and emissions per mile are much lower than in the cold start phase. For the park and ride program gross reductions in emission and fuel use are roughly proportional to VMT reduced, and may be more than proportional to the extent that VMT reduction occurs during the transition phase of the trip. However, adjustment of emissions and fuel saving to compensate for the operation of buses causes a considerable reduction in the savings/VMT. (The absolute difference in magnitude of VMT saved is attributable to the longer trips diverted by carpool lots; hence these lots amount for the bulk of the VMT reductions, even though fewer cars use them).

Conclusions

The commuter lot/express bus system in Connecticut is well utilized (parking lots are over 75 percent occupied, on average), because many factors conducive to use of these facilities are present. These include:

- serious peak-hour traffic congestion in major cities.
- rising out-of-pocket costs of driving (especially gasoline).
- suburban and exurban population growth concurrent with downtown redevelopment.
- a relatively high proportion of high-income suburban residents, who are aware of the potential cost savings possible through carpooling or use of express bus service.

residents, who are aware of the potential cost savings possible through carpooling or use of express bus service.

- strong support for ridesharing promotion and express bus programs from state and local government agencies as well as many large employers.

Attitudinal surveys indicate that the most important motive for carpooling and express bus use is cost savings; with the desire to avoid driving in congested traffic of strong secondary importance.

On the basis of data from Connecticut and previous studies, carpool and express bus parking facilities appear to be most appropriate for work trips of different lengths. Carpool lots tend to be utilized more heavily for relatively long work trips (12 to 15 miles and over) from low-density areas relatively distant from major population centers. Park and ride lots tend to be more heavily used for shorter trips (10 to 12 miles and less) from suburban to downtown areas. Carpooling provides a means of reducing travel costs in areas where demand for express bus service in insufficient.

Planning for commuter parking lots must consider trip length variations in different regions, as well as regional consideration, including population density and intersection volumes, residential employment and location trends, traffic congestion and availability of transit service. Local factors (such as accessibility of the lot and potential traffic hazards) must also be considered.

Reductions in vehicle-miles traveled attributable to the carpool lot/express bus program in Connecticut are small: about 194,612 VMT/day, about 1.04 percent of work trip VMT, and about .45 percent of statewide daily VMT. Emissions and fuel consumption savings (equivalent to about .27 percent of emissions and .65 percent of fuel consumption associated with work travel) are even less, because most of the VMT reduced occurs in the stable phase of auto operation, when vehicular emissions and fuel consumption are lower. Although the park and ride lots seem more effective than carpools in reducing gross fuel consumption, if compensation is made for the fuel used in bus service, the carpool lots are more effective. This fact, as well as the relatively greater average length of trips diverted by carpool lots accounts for their higher share of total VMT reduction, even though fewer cars use them than park and ride lots.

Only about 2.5 percent of all work trips use park and ride or carpool lots. This results from prevalent decentralized patterns of home to work travel. Most trips are relatively short (7 to 8 miles, one-way), and directed to widely dispersed destinations; this severly limits the potential share of work trips that could use commuter parking lots.

The carpool lot/express bus program is a relatively expensive TSM strategy. During 1980, ConnDOT spent approximatly $448,015 for the State share of lot expansion costs, $128,036 for lot leases and maintenance, $981,000 for express bus operating subsidies, and $232,136 for bus maintenance and equipment, for a total program cost of $1,789,187. Since an estimated 48,653,000 VMT are reduced yearly, the cost for each VMT reduced is about 3.67¢. Clearly, this is not a low-cost TSM action, and while ConnDOT has received the bulk of the funds needed for lot expansion and 50 percent of express bus subsidies from the Federal government, it is unlikely that this level of support will continue in the future.

ConnDOT has been able to reduce the cost of increasing lot capacity by using its Maintenance Office and the National Guard to build lots, and by leasing spaces from shopping centers and churches. However, there are limits to the degree of expansion that can be accomplished in this matter, and many of the most desirable sites on State land have already been developed. This implies that future lot expansion will be done increasingly by private contractors, at considerably higher cost. Leasing of lot space at shopping centers is the most feasible alternative for expansion at reasonable cost. These leased lots also generate considerable business for the shopping centers concerned.

VI. CAMBRIDGE RESIDENTIAL PARKING PERMIT PROGRAM

I. BACKGROUND

The Cambridge, Massachusetts Residential Parking Permit Program, which began in 1973, is a citywide prohibition of vehicles unlicensed in Cambridge from curbside parking on residential streets. Cambridge residency stickers are necessary for legal parking. There has also been a general reduction of 10,000 curbside parking spaces in City. The purpose of the project was to discourage automobiles from entering Cambridge and to free parking spaces for Cambridge residents in residential districts. It has been applied citywide in residentially zoned areas in this university city of over 100,000, covering six square miles. It is estimated that as of 1970 about 58,000 non-resident commuters and 35,000 non-resident automobiles used for commuting to Cambridge were affected by this program. Many classes of exemptions had to be granted and the original regulation limiting legal resident parking within neighborhoods only, not the rest of the City, was ruled unconstitutional. Quantitative "before" and "after" data on traffic volumes, modal shift and nonresident auto trips to Cambridge are not available. However, the reduction in available parking spaces and observed reduction in parking are clear.

Cambridge, Massachusetts is an important university town. containing both Harvard University and the Massachusetts Institute of Technology (MIT), and comprises most of the northern half of the inner suburban ring of downtown Boston (see Figure VI-1). Cambridge, separated from Boston only by the Charles River, is otherwise an extension of Boston, containing two satellite commercial centers: Harvard Square (three miles from the Boston CBD), and Central Square (two miles from the Boston CBD). Both of these areas are important shopping and entertainment districts with large institutional employers -- Harvard University at Harvard Square, and the City of Cambridge at Central Square. Subway stations are a short trip from downtown Boston. Harvard Square, the terminus of the Red Line subway, is only four stops from the Boston CBD. Cambridge also contains the terminus of the light rail Green Line to downtown Boston at Lechmere Square, a lesser commercial area containing the Middlesex County Court House (see Figure VI-2).

Primarily developed in the 18th and 19th centuries, Cambridge has short blocks, narrow streets, an irregular street pattern (see Figure VI-3), and a high population density of 16,000 residents per square mile. Cambridge is a "pedestrian" city. It has an excellent mass transit system for a community its size, aided by spatial concentrations at a few key nodes.

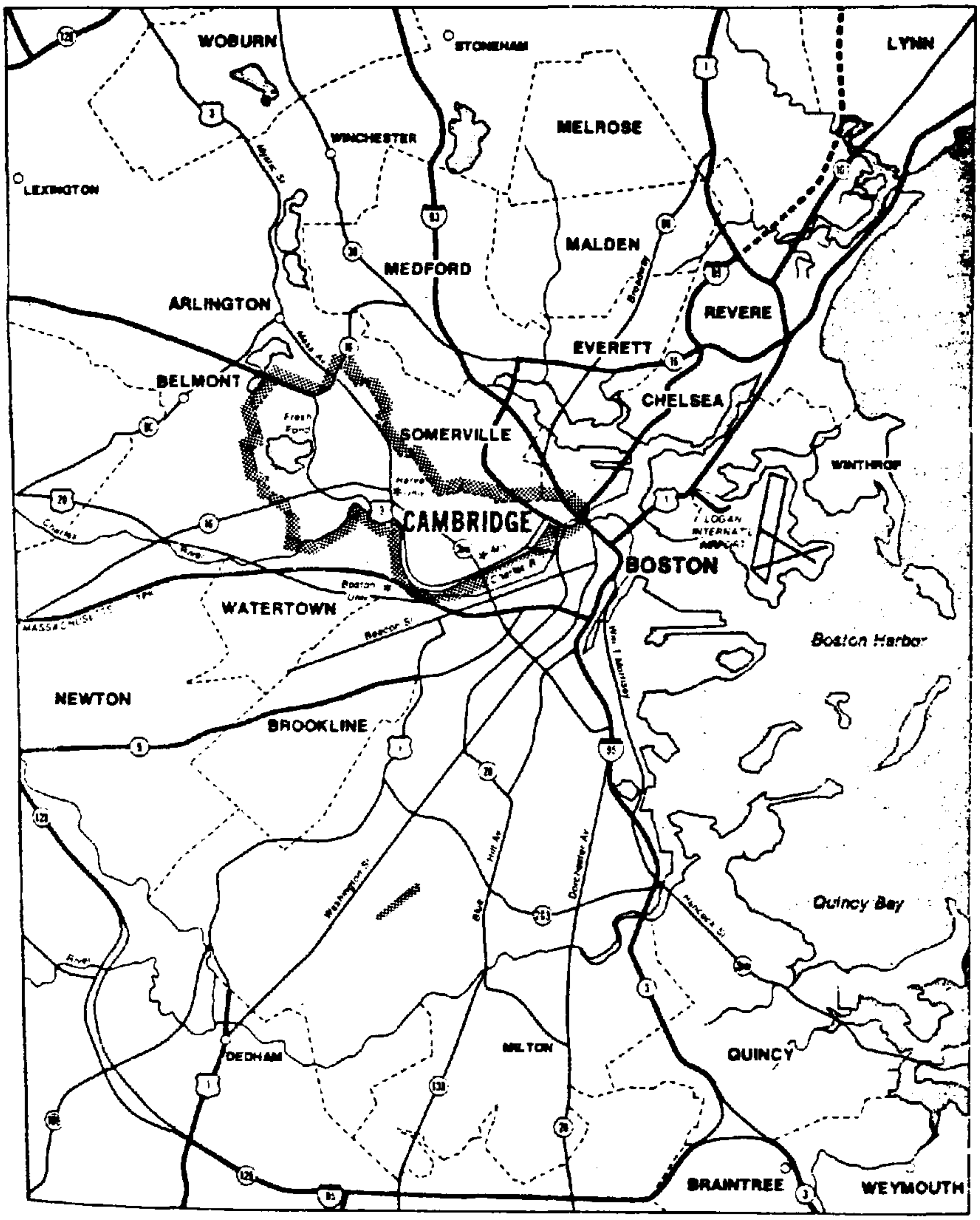
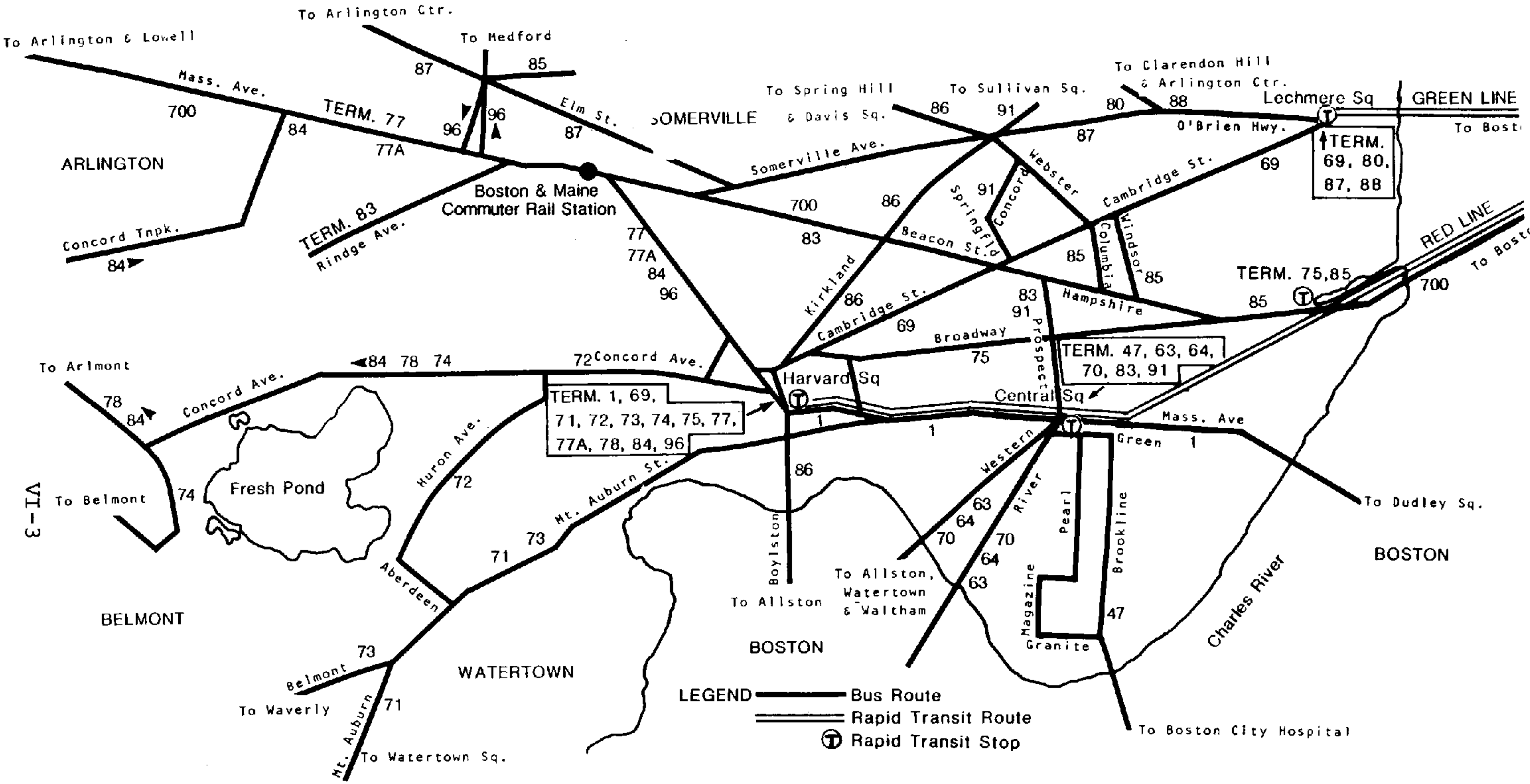


Figure VI-1:

CAMBRIDGE WITHIN THE BOSTON REGION

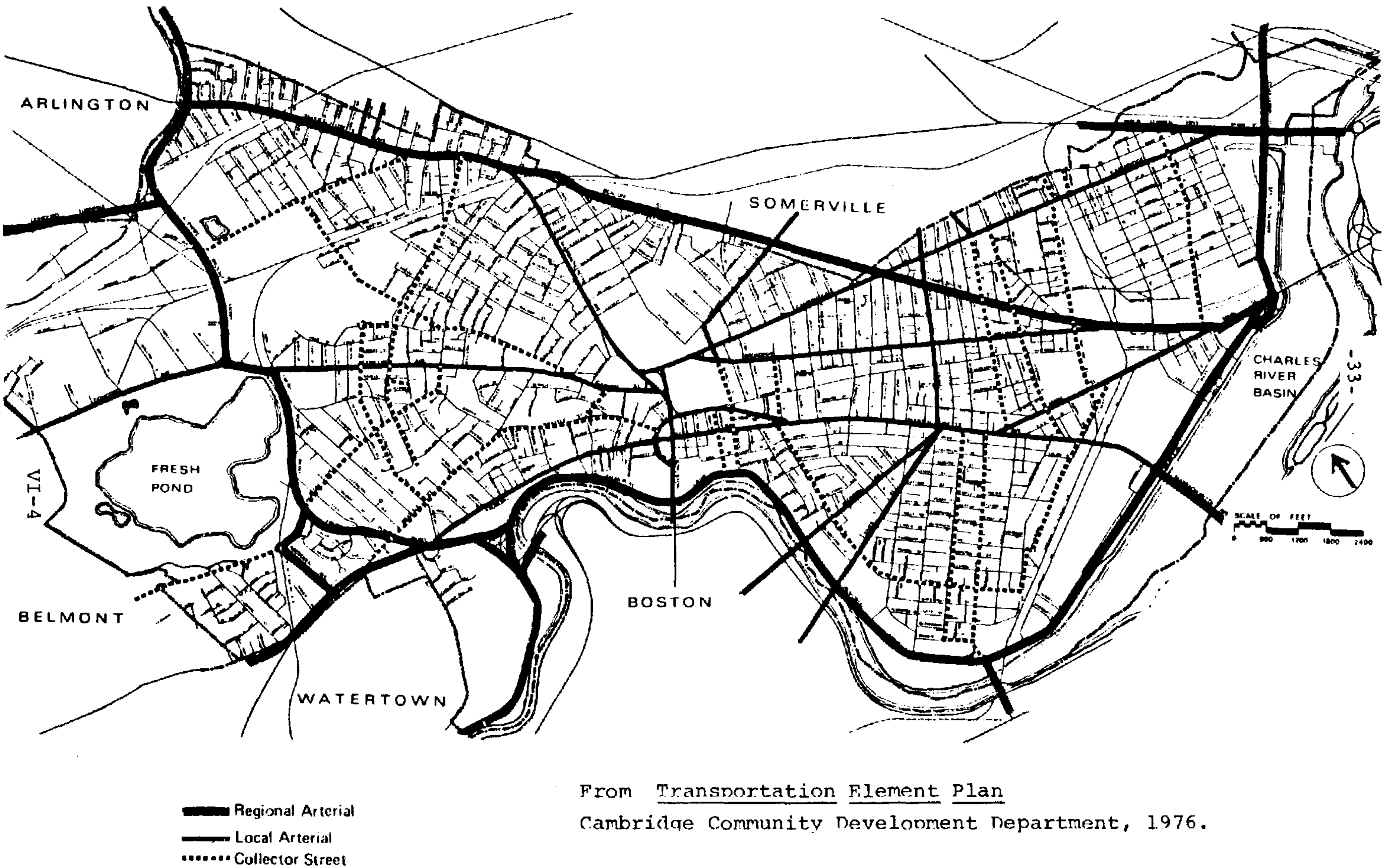
Cambridge Chamber of Commerce



1 Harvard - Dudley Station via Mass. Ave.
47 Central Sq. - Boston City Hospital
63 Cleveland Ctr. - Central Sq. via River & Western
64 Oak Sq. - Central Sq. via River & Western
69 Harvard to Lechmere via Cambridge St.
70 Watertown to Central Sq., via River & Western
70(523) Waltham to Central Sq. via Watertown Sq.
71 Watertown - Harvard via Mt. Auburn St.
72 Huron Ave. - Harvard via Concord Ave.
73 Waverley - Harvard via Mt. Auburn St.
84(528) Harvard to Hanscom Field via Arlmont and Lexington Center
85 Spring Hill - Kendall Sq. via Union Sq. (Somerville)
86 Union Sq. (Sommerville) - Union Sq. (Allston) via Harvard Square
87 Clarendon Hill/Arlington Ctr. - Lechmere via Davis and Union Squares
88 Clarendon Hill - Lechmere via Davis Square
91 Sullivan - Central Sq. via Inman Sq.
96 Medford Sq. - Harvard Sq. via Davis Square
700 Boston to Lowell (in Cambridge, stops only in Kendall Sq.)
74 Belmont Center - Harvard via Concord Ave.
75 Harvard Sq. - Kendall Station via Broadway
77 North Cambridge - Harvard Sq. via Mass. Ave.
77A Arlington Heights - Harvard Sq. via Mass. Ave.
77(529) Bedford VA Hospital - Harvard Sq. via Lexington and Arlington Heights
78 Harvard Sq. to Park Circle via Concord and Blanchard
80 Arlington Center - Lechmere via Medford Hillside
83 Ringe Ave. - Central Sq. via Porter and Inman Sq
84 Harvard to Arlmont - Outbound via Concord and Blanchard; Inbound via Mass. Ave.

M B T A
TRANSIT SYSTEM, Cambridge, Mass.
Figure VI-2

Figure VI-3 : CAMBRIDGE STREET NETWORK



From <u>Transportation Element Plan</u>
Cambridge Community Development Department, 1976.

VI-4

(Harvard and Central Squares contain 41 and 38 percent of Cambridge's business district employment, respectively[1]).

Cambridge, for these and other reasons, has had an on-street parking problem. The city has a larger number of resident-owned cars and a larger number of non-resident commuters and shoppers than other communities in Boston's inner suburban ring. However, it has the same narrow streets and limited off-street parking that characterize similar communities.

Forty thousand automobiles are registered in Cambridge, which has a population of 100,000. However, many residents register their cars out-of-town in order to avoid the high city registration surtax and insurance costs. The high automobile ownership is indicative of the large university student population (23 percent of 1975 residents)[2]. Cambridge also is the workplace of about 80,000 people of whom only 22,400 live in Cambridge.[3] The two universities alone have 14,000 employees. Non-resident commuters were driving an estimated 35,000 automobiles daily into Cambridge in the early 1970's.[4], mostly from the suburbs to the west and north of the city. Additionally, Cambridge attracts a large number of shopping, business, and entertainment trips to its university communities and growing business districts. The proportion of Cambridge residents employed in retailing has grown from 9.4 percent of its work force in 1970 to 14.3 percent in 1975, while retail establishments have grown from 881 in 1967 to 1,133 in 1972. As of 1977, Cambridge retailers and wholesalers employed 14,800 people. This retail growth has accompanied the changing nature of Cambridge from a city with a large blue collar industrial base to a service-based economy, strongly connected to the universities. Manufacturing employment declined from 26.1 percent of the work force in 1960 to 13.6 percent in 1975, much of it now high-technology out-growths from MIT. Cambridge service employment has risen over the same period from 60 percent to 66 percent.[5] Cambridge has developed the kind of economy which attracts a great number of automobile trips.

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[1]Economic Profile, Cambridge Chamber of Commerce, 1976. (Hereafter: Economic Profile.)

[2]Economic Profile.

[3]Comprehensive Planning Advisory Group, Cambridge Community Development Department, and Wilbur Smith Associates, Transportation Element Plan, September 1976: Cambridge, Massachusetts. (Hereafter: Transportation Plan.)

[4]Ann Rappaport and George Teso, Parking And The Environment: Cambridge, Massachusetts, unpublished paper, 1978. (Hereafter: Rappaport and Teso.)

[5]Economic Profile.

By the early 1970's the City was experiencing an increase in automobiles parked on its streets. Residents found it difficult to park their cars in their own neighborhoods. The City itself experienced difficulties in cleaning streets and moving emergency vehicles down narrow streets crowded with cars parked on both sides of the street.

One aspect of Cambridge's problem has been a perceived deficiency in mass transit service from the suburban towns west and north of Boston and Cambridge, where most automobiles entering Cambridge originate. The 1970 Census found that of Cambridge's work force, 28.6 percent were from Cambridge; 14 percent were from Boston; 2.6 percent from Brookline and southern suburbs; while 54.8 percent were from suburbs to the north and west of Cambridge, predominately from Somerville (11 percent) and Arlington (7 percent).[1] The northern and western suburban orientation of Cambridge's work force is logical given Cambridge's position in the northwest segment of the inner metropolitan core. However, the rapid rail transit system of the Massachusetts Bay Transportation Authority (MBTA) provides the best service to Cambridge from the southeast (via the Red Line subway), and transit routes feeding into it from Boston. The commuter rail network in the Boston metropolitan region, operated by the Boston and Maine Railroad, branches far out into the suburbs on six lines to the north and west of Cambridge. However, the destination of these trains is to downtown Boston, though two lines do make stops at Porter Square in Cambridge. The MBTA bus network radiating from Harvard Square (thirteen routes) and Central Square (seven routes) only extends beyond Cambridge a few miles into the old inner suburbs of Allston, Brighton, Belmont, Arlington, Watertown, Somerville, and Waverly (See Figure VI-4).

For outer suburbanites - even for most people within Cambridge and its neighboring communities - the automobile provides significant travel time savings over mass transit.

As of 1970, commuting to Cambridge was predominantly by automobile. Data developed by the Boston Transportation Planning Review (BTPR) indicated that only 19 percent of Cambridge's 80,000 workers used mass transit to get to their jobs. (This compares with 58 percent for downtown Boston.) The BTPR found that only 15 percent of all daily trips to Cambridge were by mass transit. Even among Cambridge residents, 42 percent commuted by automobile. The rest either walked (25 percent), bicycled (6 percent), or rode mass transit to work (26 percent).[2] Subsequent to 1970, transit ridership has risen but short distance transit commuting of Cambridgians working in

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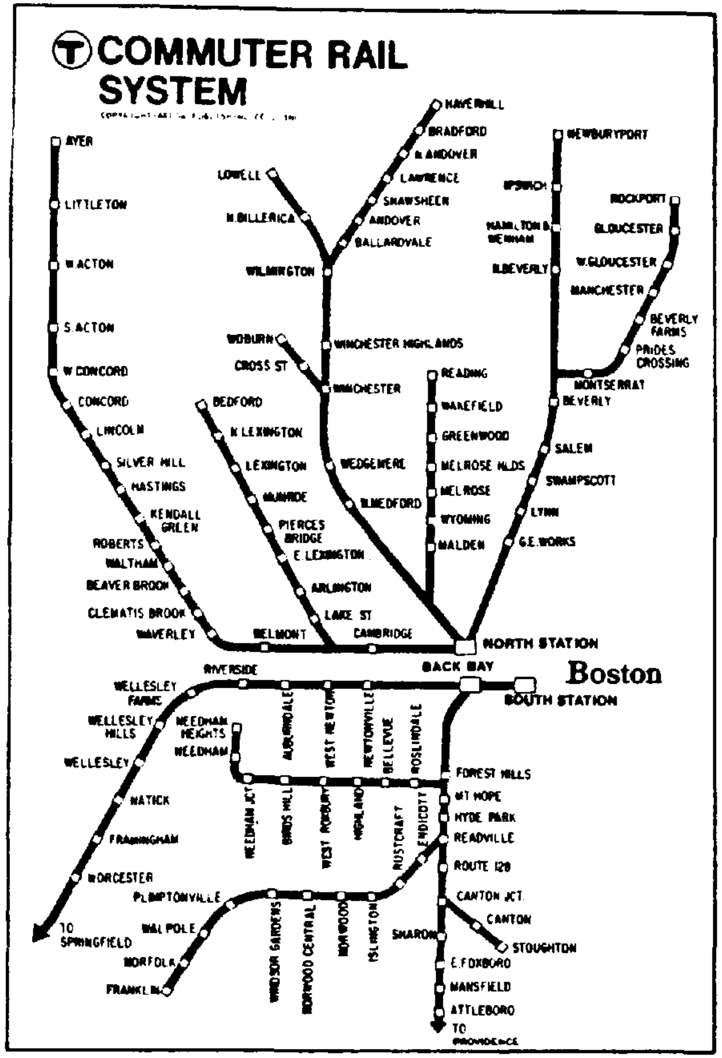
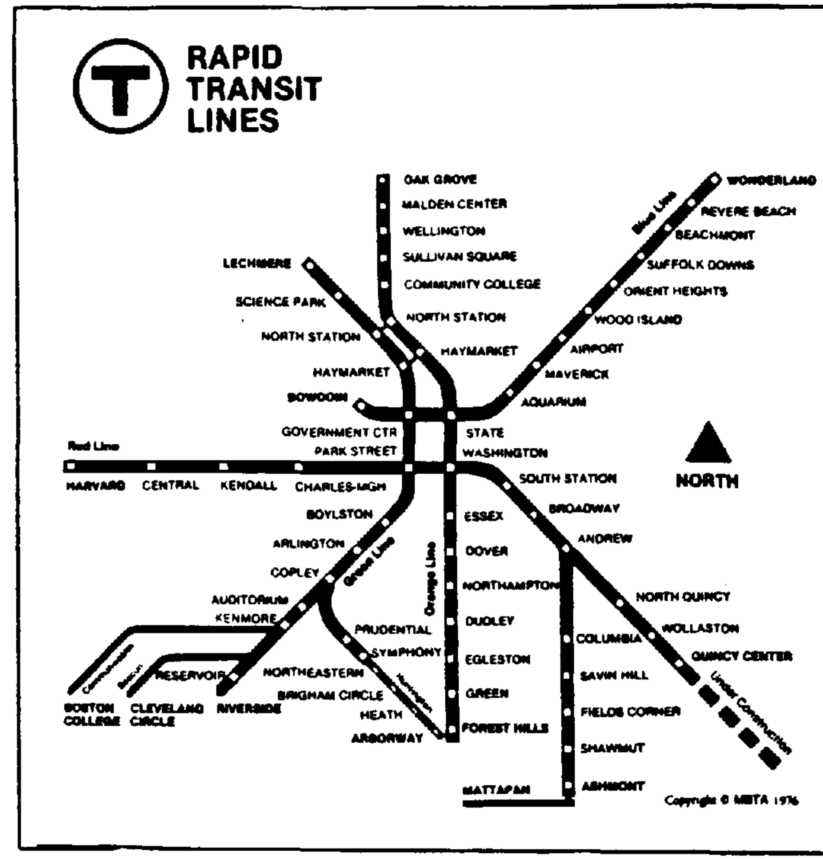
[1] Transportation Plan.
[2] Transportation Plan.

Figure VI-4 : BOSTON REGIONAL TRANSIT





Cambridge is a slower or more expensive alternative to walking, bicycling, or going by automobile.

Cambridge lacks the wide trolley-era avenues and streets Boston has, which facilitate curbside parking. Cambridge's most heavily used thoroughfare, Massachusetts Avenue, is only four lanes wide with frequent intersections. Throughout the older, central, and eastern portion of Cambridge (where most business and shopping are located), blocks are short, streets are narrow, and intersections abound. The City also lacks off-street parking. Cambridge has only three commercial parking garages, two at Harvard Square, and one at Central Square. Total off-street parking in the Harvard Square area was 1521 (1976) and 1703 (1976) at Central Square.[1]

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[1] Ibid.

II. PROGRAM PLANNING AND DEVELOPMENT

A. The Cambridgeport Experiment

The City of Cambridge originated its present residential permit parking program (RPPP) in response to residents' complaints over non-resident use of "their" curbside parking spaces. Given the tens of thousands of automobiles being driven into and parked in Cambridge each day by workers, students, shoppers, servicemen, sales people, and visitors, popular pressure for limits on non-resident parking was to be anticipated. However, the program began on a neighborhood scale without much planning, to solve a local problem which had become a political issue.

Residents just north of the Boston University Bridge in Cambridgeport objected to the heavy parking use of streets in their neighborhood by Boston University students who could park in Cambridgeport and walk over the bridge to class. After a series of neighborhood meetings and unsuccessful experiments with time-restricted parking regulations on these streets, the City decided to seek powers from the Commonwealth of Massachusetts to ban non-resident parking.

While the motivation for the residential permit parking program was to solve one small neighborhood's problem, Cambridge's representatives in the State legislature secured broad powers for their City's Traffic Director giving him power to decree and enforce residency restrictions on parking throughout Cambridge in May 1972, under Chapter 340, Acts of the General Court of Massachusetts, 1972.

The Cambridge Department of Traffic and Parking then organized a resident sticker parking program in that area of Cambridgeport in October and November of 1972. This was preceded by extensive newspaper advertising of the impending program, and mailings to each household in the area, informing them to bring their automobile registrations to the Department in order to obtain $1.00 residency stickers for their cars. Three hundred ninety-six stickers were issued in an area containing 643 households. By January 8, 1973, when police enforcement of the ban against non-resident parking began, "PARKING BY PERMIT ONLY" signs had been installed on all affected streets. The program was successful, and the number of violations decreased from 132 to 29 from the eighth to the twenty-sixth of January. By February 1, 1973, the Department of Traffic and Parking found less than a third of non-compliant automobiles still parked in the area than had been there prior to enforcement.[1]

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[1] Resident Parking Sticker Program, February 2, 1973. Report from George Teso, Traffic Director to John Corcoran, City Manager. (Hereafter: Teso to Corcoran).

The shortcomings of this experimental program soon surfaced, and complaints were voiced that the program was too strict and should exempt some vehicles. In order to revise the program, it was suspended for two months so that more hearings and discussion could be held. The complaints concerned vehicles belonging to: customers of small stores and services, salesmen and contractors working in the area, guests of residents, those attending church and school functions, people who work in the neighborhood but do not live there, patients of neighborhood doctors and other home/office services, residents with rented or borrowed vehicles, and those (especially students) with cars registered outside Cambridge. The last category was large even among permanent residents because of the high vehicle registration taxes imposed by the City and the Commonwealth and the high vehicle insurance costs for the Boston area. Despite these complaints, the residential permit parking program was generally popular with residents.

As a result of these complaints, the program was reinstituted in March 1973 with the following modifications:

1. Two portable visitor parking permits were issued to each resident of the area.

2. Five similar permits were issued to each doctor or similar professional with an office in the area.

3. Commercial vehicles were exempted if properly registered as such and identified by company name, address, and phone number so that their business in the area could be verified.

4. Loading and unloading vehicles were exempted.

5. Telephone notification of parties, meetings, school and church functions would exempt vehicles assumed to be used by attendees at these func- tions.

6. Resident stickers would be issued for rented vehicles.

7. Special exemptions were made for visiting nurses, handicapped people, and other special cases.

8. At the owner's request, time-limit spaces in front of businesses would be exempted.

9. Sunday was omitted from the regulations.

Special arrangements could also be made at the discretion of the Traffic Director. However, the city insisted that residents' vehicles must be registered in Cambridge to qualify for permits.

In essence, this modified Cambridgeport residency restrictive program is the same as the one presently applied throughout Cambridge. It provides for Cambridge residents with automobiles registered in Cambridge to park in their neighborhood, and for some classes of non-residents to park for limited periods as well. While the modified Cambridgeport program proved locally quite popular and solved the Boston University student problem it was intended to solve, the program's results were not entirely positive as some of the unwanted autos began appearing in other residential neighborhoods of the city.

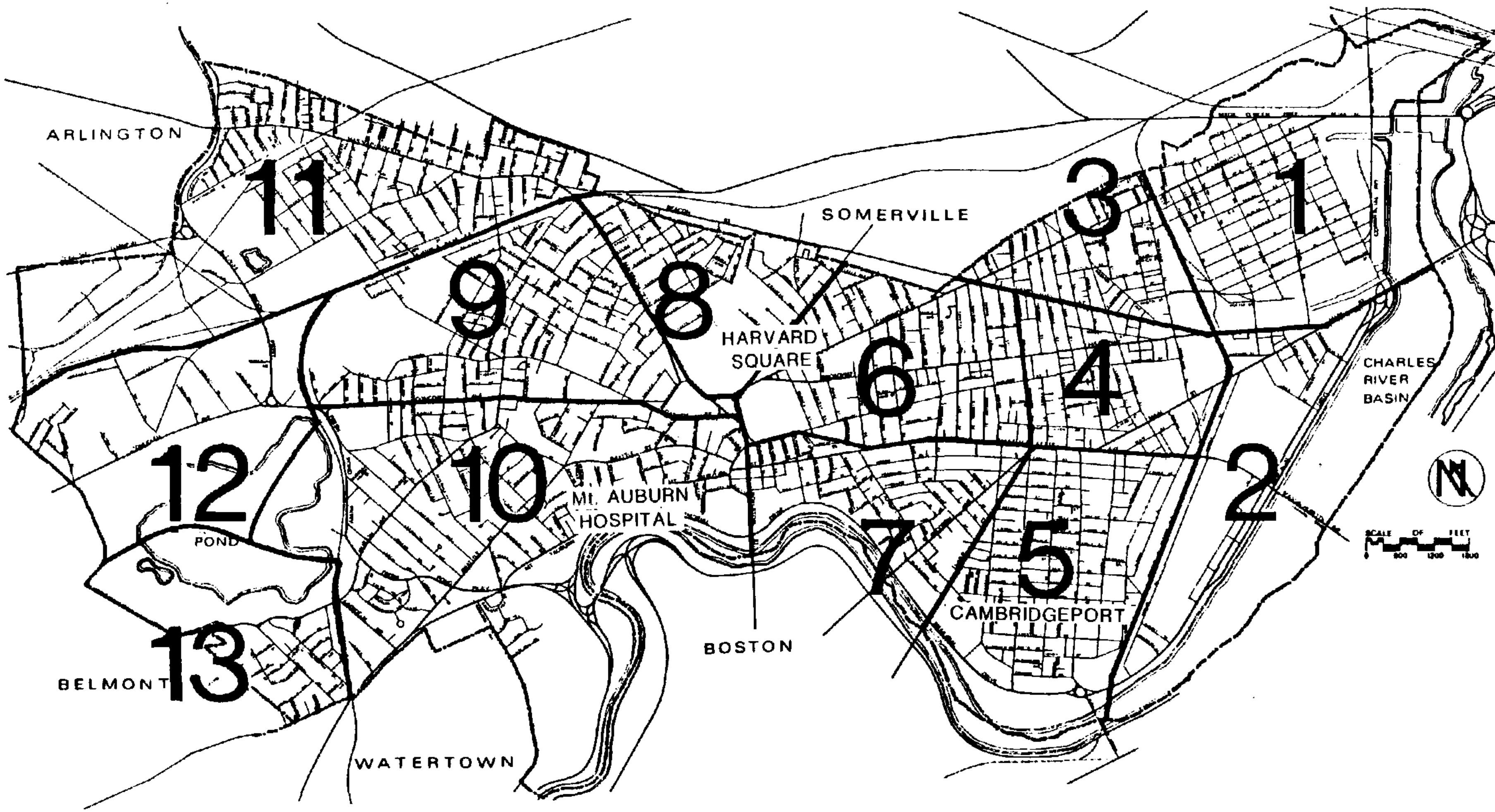
B. Extension Of The Program

The success and popularity of the Cambridgeport residential permit parking program led to a demand by other neighborhoods for similar residency restrictions. This was, in part, because there were other areas of the City with heavy non-resident parking on residential streets, and in part because as cars were banned from some residential streets, they simply parked on nearby streets without prohibitions. This "spillover" or displacement of illegal parking by itself has expanded the enforcement area to include nearly all of Cambridge and has spilled over Cambridge's border into Somerville, where similar enforcement is beginning on streets near the border.

Many Cambridge neighborhoods were experiencing much non-resident parking from Cambridge commuters, shoppers, students, and some Boston commuters who could park near Cambridge's transit stations.

The program was imposed next on the Mount Auburn/ Brattle Street area. This was at the request of residents who objected to workers and visitors of the Mount Auburn Hospital parking on residential streets in order to avoid paying to park in the Hospital garage. This problem was also largely solved to the satisfaction of local residents. Subsequently, residents around Harvard Square complained of spillover parking onto residential streets there, and the program was applied to a ring of residential streets circling this major commercial district.

In all three neighborhoods where this restriction was first applied, parking stickers were issued to residents of the immediate neighborhood. Cambridge residents from other neighborhoods without stickers were banned as were those from out of town. As more neighborhoods requested that the program be extended to their areas, sentiment grew for a city wide program. The City instituted a city wide program later in 1973. Residency stickers and color-coded visitor permits were issued under this program with a different color for each of Cambridge's thirteen official neighborhoods (See Figure VI-5). The great majority of streets in each district were signed for



CAMBRIDGE NEIGHBORHOODS
Figure VI-5

such permit parking only and the restriction routinely enforced. One effect of the program was to make it difficult for residents of one district of Cambridge to park in another part of town, even if only a few blocks away. While the program did not guarantee residents a curb side parking place by their homes, it did greatly increase the probability.

C. Court Cases

The least popular aspect of the residential permit parking program was the program's prohibition against Cambridge residents parking in districts of the City they did not reside in. A Fresh Pond resident, ticketed after parking near the Middlesex County Court House, successfully challenged this aspect of the City's program in the Commonwealth Versus Henry P. Sorett (1974). The Middlesex County District Judge ruled that the program was in violation of the equal protection clause of the Fourteenth Amendment to the United States Constitution because it discriminated among Cambridge residents. However, the Judge maintained that permits available equally to all Cambridgeans would be constitutional.

Consequently, the program was altered and all Cambridge residents could get stickers which would allow them to park on any restricted residential street whether in their district or not. This meant, for instance, that Cambridgeans from all parts of the City could park on residential streets above the Boston University Bridge in Cambridgeport, around the Mount Auburn Hospital, or near Harvard Square, partially undoing the residency restrictive situations in those areas. Generally, this modified program made intra-city automobile movement easier. However, the district restrictions still apply to visitor permits, which are color coded for each of the thirteen City districts.

The residency parking restriction problem as a whole was challenged in 1975 (Commonwealth versus Guy A. Petralia) as unconstitutional under the Fourteenth Amendment. The Massachusetts Commonwealth Supreme Court upheld the City's residential permit parking program stating that:

> "the basic question is whether the classification made by the regulation rationally furthers a legitimate State purpose...We think that a regulation which discourages persons from driving their automobiles to the congested neighborhoods....deals rationally with the public interest in reducing highway congestion, in reducing air pollution, and in encouraging the use of public transportation in the place of private transportation.
>
> We turn then to the question whether the Cambridge parking regulation's distinction between Cambridge residents who have obtained parking permits and all others

rationally furthers one or more of these legitimate State interests....

We conclude that the placing of motor vehicles of residents of Cambridge in a category apart from all other motor vehicles is not irrational....Those Cambridge residents most interested in parking in the restricted area are those who live in it. If they leave their cars parked near their homes, they contribute nothing to air pollution or to the congestion of moving traffic on the highways. In general, those Cambridge residents who do not live in the restricted area but are permitted to park in it have a shorter distance to travel and will contribute less to air pollution than will persons driving to the restricted area from other municipalities. Legislative classifications need not be perfect in order to survive a challenge on equal protection grounds....

The discrimination made by the Cambridge regulation is based rationally on the use or non-use of a motor vehicle. A resident who parks near his home is not using his automobile, whereas a person who parks in an area away from his home has used his vehicle and thus has contributed to the problems which the Cambridge regulation seeks to address. The rational distinction made by the Cambridge regulation is founded on vehicle use. Place of residence is merely a reasonable means of measuring that use."[1]

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[1] Commonwealth vs. Petralia, 1975

III. PROGRAM IMPLEMENTATION

With the legality of the program upheld, the City of Cambridge has extended the program to cover about 95% of all streets in the City, the balance being low density residential areas where no parking problem for residents has arisen. Signs have been posted on these streets (see Figure VI-6) and the program publicized in the Boston area.

A major impetus to the establishment of the permit parking program citywide was the coincidence of the neighborhood's demand for this program with efforts by the Federal Environmental Protection Agency to enforce the 1970 Clean Air Act through a Transportation Control Plan (TCP) for the Boston area issued in 1973. A large part of this plan involved the elimination of curbside parking in the inner city of Boston to be partially replaced, if desired, by more off-street parking. The goal was to "freeze" the number of parking spaces existing there as of October 15, 1973 and gradually replace curbside parking spaces with half that number of off-street spaces, or less.

Cambridge was concerned that they were not part of the 1973 Transportation Control Plan for the Boston area. They sought to be included because of: 1) popular concern that after the reduction in Boston's parking supply Cambridge would become "Boston's parking lot" for CBD commuters; 2) the political advantage of making their parking program permanent and a matter of federal not just local enforcement; 3) the possibility of some federal funding for the program. The EPA amended its Transportation Control Plan (1975) to include all of Cambridge in the parking "freeze area".[1]

The uniqueness of the Cambridge element of the Transportation Control Plan is that the initiative, development, and monitoring of enforcement were municipal, not federal, and that it was the product of popular demand. Cambridge is now the only municipality in Massachusetts and one of only a handful in the nation to be <u>entirely</u> covered by a residential permit parking program and the <u>only</u> one to make the restrictions effective twenty-four hours daily on nearly all residential streets. "Residential Streets" are all those non-arterial streets within residentially zoned districts (see Figure VI-7). Cambridge also added to the RPPP by having inserted into the TCP a 7-10 a.m. weekday ban on non-residential streets for non-permit vehicles except at metered spaces -- a strict measure designed to eliminate all commuter curbside parking in Cambridge.

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[1]U.S. E.P.A., Implementation Plans: Transportation Control Plan for Boston, Massachusetts, Promulgation of Final Amendments, Part II, Federal Register, Volume 40, #114, June 12, 1975, Washington D.C. (hereafter: TCP).

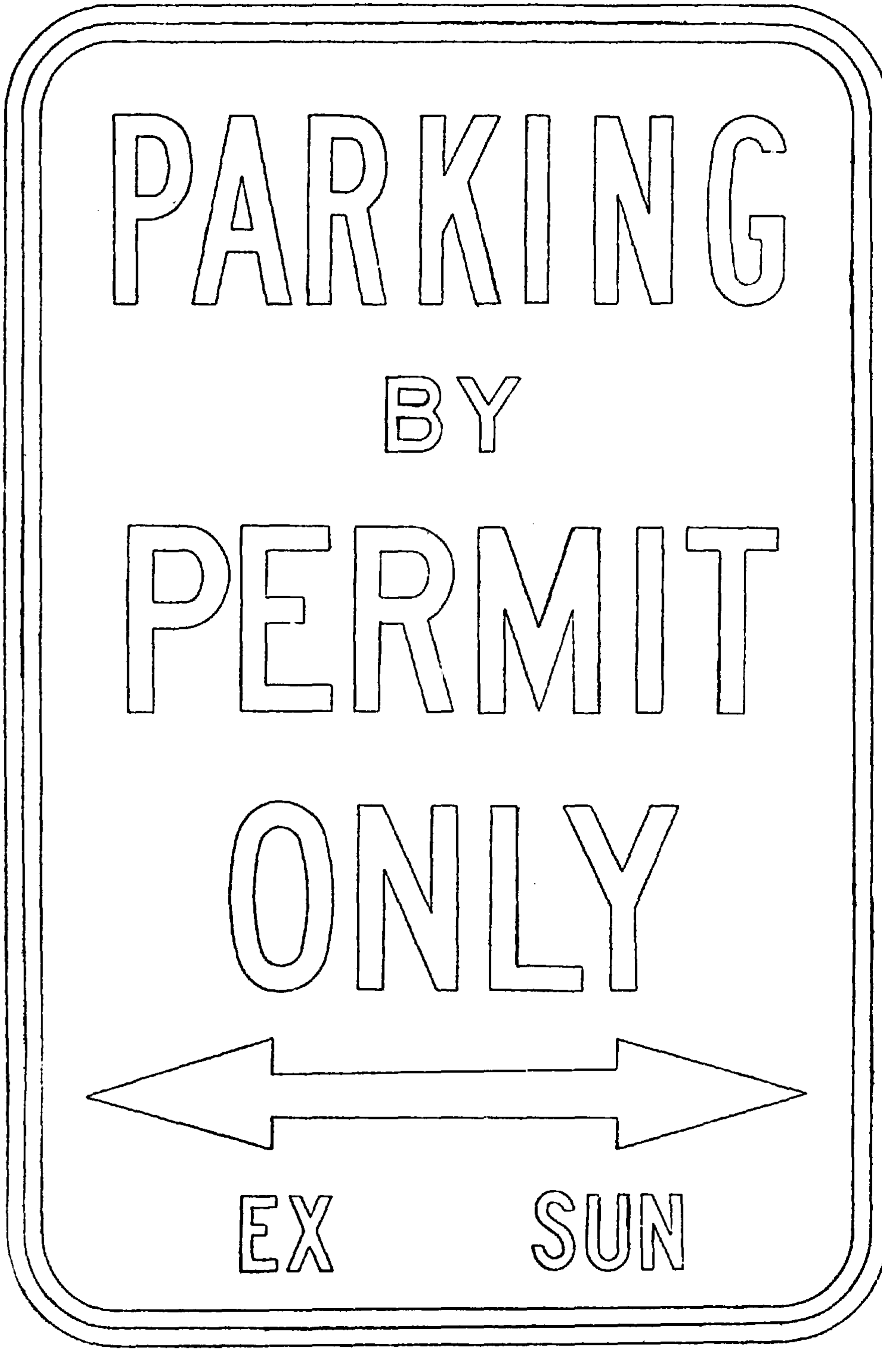
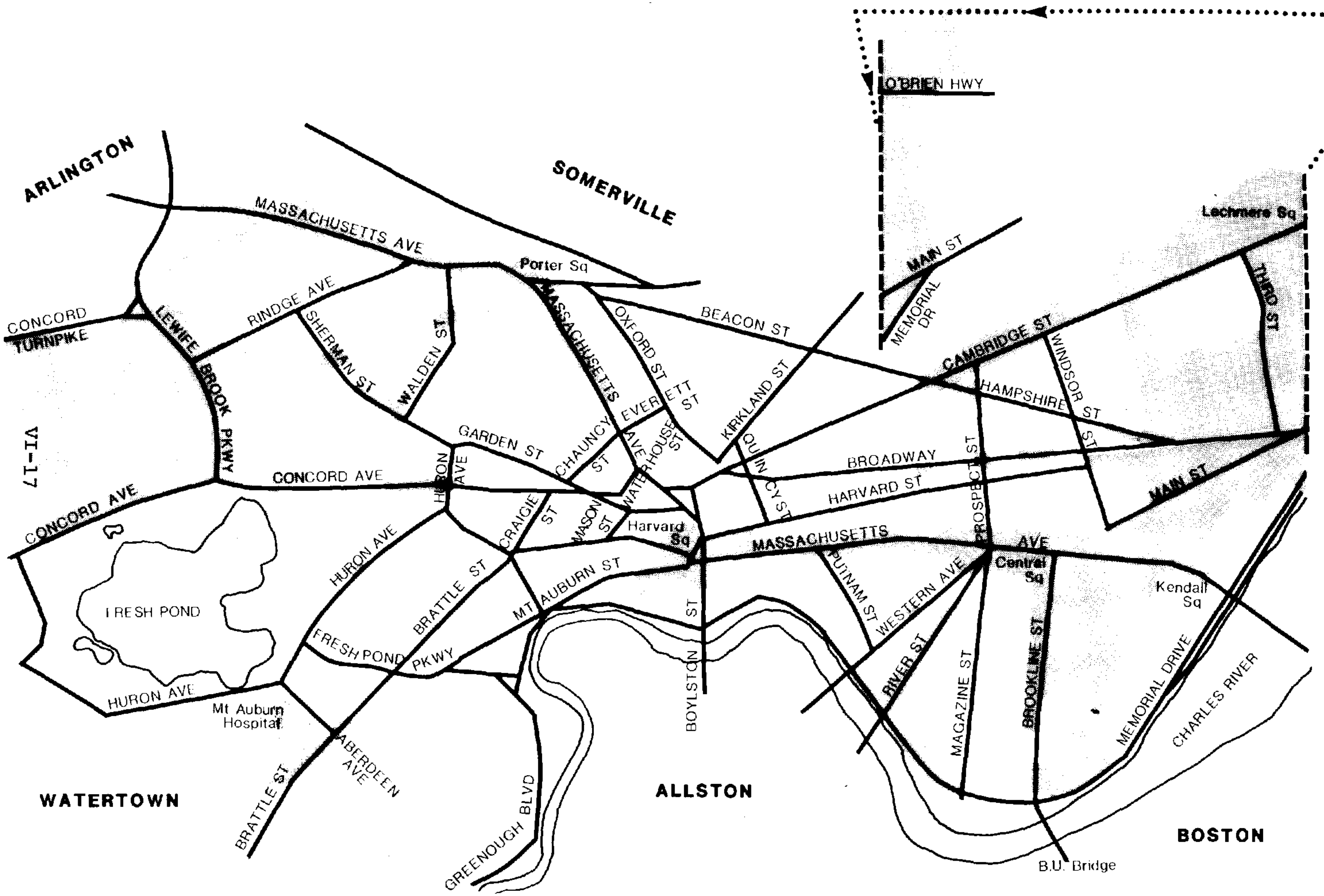


Figure VI-6



Shaded Areas : Non-Resident Areas

Figure VI-7 RESIDENTIAL (RESIDENT STICKER PARKING) & NON-RESIDENTIAL ZONES, CAMBRIDGE

Under the Transportation Control Plan, Cambridge has eliminated about 10,000 parking spaces for non-residents. Under EPA guidelines they may add one off-street space for every two curbside spaces they eliminate, hence a "bank" of 5,000 potential off-street spaces exists which Cambridge could build. A number of curbside parking spaces have been entirely eliminated for residents and non-residents alike; these can be traded in on a one-to-one basis for off-street parking. However, there has been only a small increase in Cambridge's originally scarce supply of off-street parking since the residential permit parking program was instituted. So the City has seen an enormous net decrease in parking available, especially for non-residents. City agencies have discussed plans to eliminate even more parking by: 1) instituting alternate side of street parking prohibitions to facilitate cleaning, snow plowing, and garbage collection, 2) making all meter parking one hour, and 3) by eliminating all save commercial vehicle parking within 1,500 feet of rail rapid transit stations.

Given the lack of off-street parking, many of the estimated 14,000 (1970) non-Cambridgian commuter cars using curbside parking[1] had to either go somewhere else or seek special exemption. The City made allowances for special "severe economic hardship" cases, granting exemption stickers. This "hardship" exemption policy was accepted by the Federal EPA and incorporated in its 1975 Transportation Control Plan for the Boston area, granting the Cambridge Director of Traffic and Parking the power to grant such exemption stickers on specified streets or areas.[2]

The "Procedures for Obtaining Resident Parking Permits" (Appendix VI-A) are the City's explanation to its residents on how they can use the program. The policy is to provide residents who have their vehicles registered in Cambridge, with residency stickers good on all the City's residential streets and to provide them with two Visitor Passes as well. Exceptions from this policy have already been noted.

The program is administered by the Cambridge Department of Traffic and Parking. This Department issues and revokes permits, and enforces the program during the day and evening; overnight enforcement is left to the Police Department. The Traffic Department is authorized twenty-five Parking Control Officers (PCO's), but only sixteen are not retained by the City. These sixteen PCO's are unarmed, mostly female, and operate in pairs, walking along all signed streets to issue tickets on assigned routes. The PCO's, popularly known as "meter maids," also watch out for bogus permits and for abuse of Visitor Permits, a common problem. Some residents have

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[1] P.9, Transportation Plan.
[2] TCP.

given or sold their Visitor Permits to non-residents and some visitors have used them for longer than the fifteen-day period they are allowed. Several hundred Visitor Permits have been revoked since the program's inception; these are not replaceable except under unusual circumstances. Officials admit that a "black market" of counterfeit Visitor Permits exists but feel the problem is under control because these permits are now printed by a very sophisticated three-color process, difficult to duplicate.

Cambridge officials have been pleased by the fiscal aspects of the RPPP. The figures provided by the City Traffic and Parking Department (see Appendix VI-B, "Cost of Resident Parking Program") indicate it is profitable. The Department feels the decrease in their Parking Control Officers from twenty-five to sixteen was unwarranted and leaves them shorthanded. They argue that since the PCOs bring thousands of dollars into the City treasury, the PCOs pay for themselves. The Department also likes to point out that: 1) the hiring of PCOs frees the Police for more critical tasks as the lower salaried PCOs can perform parking regulation enforcement; 2) proper enforcement with an adequate number of PCOs frees critical parking space for resident and commercial purposes; and 3) the RPPP in general has raised local revenues by forcing more Cambridge residents to register their cars in Cambridge.

The program could be more profitable. The City is dependent on the Middlesex County District Court to actually collect fines. However, the collection powers of the Court are limited. Lauren Preston estimates that only half the fines are collected, with the biggest problem being out-of-staters, who are perhaps a quarter of the violators. Moreover, the City is prevented by Massachusetts law from charging more than $15 maximum per violation, a rate which has not been raised in over twenty years. This maximum penalty is only imposed in "Resident Parking Only" areas; $10 fees are imposed for parking in taxi stands or during street cleaning periods; and $3-$5 for other violations. Finally, the City had not raised its $1 residency permit fee since the inception of the program in 1972 until July 1981 when it was raised to $2.00. This user fee represents one of the City's ways to obtain revenues in the wake of property tax limits imposed by Massachusetts Proposition 2 (1980) which limits property tax increases to 2 1/2 percent per year. Washington, Baltimore and other communities already charge $5 for resident parking permits.

IV. PROGRAM IMPACT CONCLUSIONS

A. Traffic and Parking

The impact of Cambridge's residential permit parking program is difficult to evaluate because of the scarcity of thorough "before" and "after" data. License plate or other origin surveys were not taken of non-resident automobiles before the RPPP began. 1980 Census "Journey to Work" data has not yet been released to allow comparison with the 1970 Census pattern of commuting to Cambridge. This would be one good method of evaluating the RPPP's effectiveness. Traffic cordon counts and arterial counts from 1971 to 1980 do not demonstrate a clear pattern.

What is known is that a large decrease occurred in the City's on-street parking supply, affecting an estimated 14,000 non-resident commuter cars in a city with little off-street parking. Efforts to build more off-street parking in Cambridge have not gotten far because it is deemed uneconomic. A recent Community Development Department design for a new East Cambridge garage used $12,000 per space as the projected cost. Resident opposition forced the proposed 5,000-space park-and-ride lot at the proposed Alewife Brook Red Line MBTA station on the northwest outskirts of Cambridge to be scaled down to 2,000 spaces. Many residents have attempted to rent driveway space to commuter cars or to increase their driveway areas to accomodate more cars (although the City tries to discourage this practice.)

What is generally acknowledged is that the residential permit parking program has made resident parking easier in Cambridge and largely eliminated the commuter parking problem for Cambridge residents. Observations and unsummarized Traffic Department surveys in two test areas indicate a decline in the number of autos parked from what was observed before the RPPP began. The Traffic Director has reported that he has received no requests since September 1980 for more residential parking and that at least four other Boston area suburbs are interested in emulating the Cambridge residential permit parking program in part or whole.

B. Economic Impact

Many in the Cambridge business community feel the residential permit parking program is too extreme and does not allow for enough metered spaces for shoppers, restaurant patrons, and others driving into Cambridge to spend money there. While no clear data indicating a decline in retail sales or commercial employment has been presented, many retailers are concerned about suburban patrons being scared away by the Cambridge regulations and turning to competing suburban malls, which have abundant and free parking. This tendency to avoid Cambridge is especially strong among those who have been ticketed or who have had their cars actually towed. Towing is performed by the Police Department but only in cases where a car has been parked illegally for over 24 hours on a residential street, is in a business district tow-away zone, or has had five or more unpaid tickets charged against its registration. Cambridge Chamber of Commerce representatives have commented on the "aggressiveness" of the Parking Control Officers, the inflexibility of the regulations, and the general bad image the City has in the Boston area business community because of the RPPP and other policies. This image is due to a combination of neighborhood-initiated restrictions on plant expansion, private off-street parking, zoning, as well as lack of available curbside or publicly available off-street parking. All this, some business leaders argue dissuades business meetings, expansion, and the establishment of new firms from taking place in Cambridge. Nonetheless, proponents point to the fact that Cambridge is undergoing a building construction boom and there are indications the local economy is stronger than before the program.

Most firms are heavily dependent on automobile access for their patrons. Any limit on nearby available parking puts a limit on the amount of business the firm can do, putting Cambridge firms in a bad competitive position against suburban establishments with abundant parking. Such localized parking shortages can be counter-productive to traffic and air pollution reduction by forcing would-be parkers to circle around searching for spaces. In the long run, a shortage of spaces would further be counter-productive by channeling commercial and population growth to the outer suburbs.

The problem areas most often cited for businesses in Cambridge were the periphery of commercially zoned areas where "spillover" parking tends to go but is banned because these areas are zoned residential. The residentially zoned side streets just north and south of Massachusetts Avenue between Harvard and Central Squares are frequently cited as an example. Many newer firms came into this strip soon after the RPPP began. Subsequently there has been a reduction of legal spaces as exemptions were gradually removed. Many of the newer firms also tend to draw exurban and outer suburban commuters, who have the greatest travel time advantage in driving versus taking the Boston and Maine Railroad into Cambridge.

A positive by-product of the RPPP for commerce has been a slight enhancement of commercial vehicle parking with easier loading and delivery operations.

C. Environmental Impact

The environmental impact of the Cambridge RPPP cannot be accurately determined. While there has been a great decline in the number of parking spaces available and a noticeable decline in daytime parking on residential streets, complete "before" and "after" data has not yet been collected describing: street traffic volumes, vehicle idling, increased vehicle cruising to find available parking, off-street parking utilization, traffic entering Cambridge, or air pollution levels within the City. It may be reasonably inferred that the program has tended to discourage automobile travel by non-resident commuters and shoppers and reduce vehicle emissions along business district sidewalks, but this has not been quantified.

D. Mass Transit Impact

No clear evidence exists that the program has caused a modal shift by commuters to mass transit. While annual ridership on the Boston and Maine's Ayer commuter rail line, which stops at Porter Square, Cambridge, grew over 50 percent between 1976 and 1980 (793,000 to 1,191,000 annual riders), the MBTA rapid rail ridership has grown only slightly between 1972 and 1978 (see Table VI-1). Few Boston and Maine trips terminate in Cambridge; it is predominately a Boston CBD-oriented mode.

E. Residential Permit Parking Program Enforcement Problems

Some deficiencies in RPPP enforcement were cited by knowledgeable individuals. These included: 1) nighttime enforcement when the Police Department, not PCOs enforces the program and only responds to residents' calls; 2) "black market" abuse of visitor permits; 3)"spillover" parking in neighboring Somerville and Allston; 4) political abuse of RPPP permits, especially around the County Court House near Lechmere Square; and 5) the inflexibility of the program for long-term visitors and new residents who cannot establish residency or change their registrations immediately.

One aspect to the enforcement concerns the problems that new Cambridge residents have complying with the program. Proof of residency may take a few weeks to establish as renters may not be in possession of utility bills or rent receipts and may not have leases in their name. Until they do prove residency to the satisfaction of the Traffic Department and have the time to come over during business hours, their automobiles are vulnerable to ticketing.

TABLE VI-1

AVERAGE DAILY PASSENGER USE
CAMBRIDGE RAPID RAIL TRANSIT STATIONS

Station	1972	1975	1976	1977	1978
Harvard Square	24,116	22,954	23,347	25,049	25,918
Central Square	8,783	9,572	9,292	10,344	10,427
Kendall Square	5,318	5,208	3,411	5,965	5,845
Lechmere Square	7,611	6,980	6,730	6,368	6,867
Stations Total	45,828	44,714	42,780	47,726	49,057

SOURCE: Cambridge Community Development Department

PROCEDURES FOR OBTAINING RESIDENT PARKING PERMITS

1. ELIGIBILITY: Any motor vehicle owned by a resident of the City of Cambridge registered under the General Laws of the Commonwealth of Massachusetts and principally garaged in the City of Cambridge.

2. HOW TO OBTAIN THE PERMIT: Upon receiving in the mail, the application card for a permit, the resident should check all the information on the card for its accuracy. He or she should then take the application card along with his or her motor vehicle registration to the Traffic and Parking Department, 57 Inman Street, Cambridge, Massachusetts. The Traffic Department will then issue a Resident Parking Permit to the applicant.
The fee for this permit is $1.00.

3. WHERE DOES THIS PERMIT ALLOW YOU TO PARK: This permit allows you to park in any Resident Parking Area in the City of Cambridge. These areas will be posted with signs stating "Parking By Permit Only , except Sundays". These "Permits" in no way allow you to park illegally, you must still obey all the parking rules and regulations of the City of Cambridge.

4. VISITOR PARKING PERMITS: Each household in a Resident Parking Area will be issued two (2) portable visitor permits that shall be used for visitors of the residents of the area. At no time should they be used for commuters or people who work in Cambridge and use the public ways for a parking lot.

5. WHAT IF I DO NOT OWN A MOTOR VEHICLE: Any resident who lives in a Resident Parking Area is eligible to receive two (2) visitor permits per

household. He or she should take some proof of residency, such as a rent receipt or electric light bill along with some means of identification to the Traffic and Parking Department and upon verification of residency, they will be issued two (2) visitor permits.
The fee for these permits is $1.00.

6. VIOLATORS: Any person who parks in a Resident Parking Permit Area without a permit or visitors' permit will be issued a parking ticket and the fine for this violation is $15.00.

The Traffic and Parking Department will be making periodical parking checks to determine how the program is working and to make sure that the visitor permits are not being abused. If the Department finds that they are being abused, the visitor parking privilege will be taken away from the individual that they were assigned to.

7. LOST OR STOLEN PERMITS: If a person looses or has his permits stolen, please notify the Traffic Department at once. This will enable the Traffic Department to watch for the stolen or lost permits during their parking checks.

8. CHANGING MOTOR VEHICLES: If for any reason you are changing your motor vehicle such as buying a new one or selling your old one, please remove the sticker from the vehicle and bring your new registration to the Traffic Department and they will void the old sticker and issue you a new one.

9. GENERAL INFORMATION: The Traffic and Parking Department office is open from 8:30 AM to 5:00 PM, Monday thru Friday but during the months of January and February. They will be open Saturdays 8:30 AM to 5:00 PM to accommodate those people who cannot get there during the week.

For any information concerning the Parking Permit Program, please call 876-6800, Ext. 314.

CITY OF CAMBRIDGE

57 INMAN STREET, CAMBRIDGE, MASSACHUSETTS 02139 . TEL. [illegible]
498-9042

DEPARTMENT OF
TRAFFIC & PARKING

George Teso
Director

COST OF RESIDENT PARKING PROGRAM

A. SIGNING

1) Material:

Posting 70 miles of residential streets in City where parking is allowed.

12"X18" Black on white reflective sign face on aluminum sign blank

Sign face	$2.50 ea.
Sign blank	2.50 ea.
Sign Pole	4.00 ea. (50% of the inst. req. pole)
Mounting Hardware	1.00 ea.
	$10.00/sign

4000 signs installed @ $10.00/sign = $40,000.00

2) Labor:

3 man crew installed 25 signs/day
160 working days required use 3/5 of a yr.
Average salary =$15,000.00/man/yrX3=$45,000.00/crew/yr.
X=3/5=$27,000.00
Overhead & benefits 50%=$13,500.00
Truck cost $15.00/hr. for 5.5 hr./day=$13,200.00
Supervision $8.20/hr. +$4.10/hr. overhead & benefits-$12.30/hr.
Use $12.00/hr. =$14,400.00

Crew	$40,000.00
Truck	13,200.00
Sup.	14,400.00
	$67,600.00

Call	$65,000.00
+ material	40,000.00
	$105,000.00

B. YEARLY OPERATION (Resident Sticker Office)

Requires 1½ people for the full year
Rate of pay $8,000.00/person X1½=$12,000.00/yr.
Benefits =$ 6,000.00
$18,000.00

Material:	Stickers	$ 3,000.00
	V.P.	1,000.00
	Admin.	1,000.00
		$ 5,000.00
Computer Processing		16,000.00
		$21,000.00
	Labor	18,000.00
		$39,000.00/yr.

C. ENFORCEMENT OF RESIDENT PARKING REGULATION

Parking Control Officers are assigned to cover the whole city and enforce ALL parking violations.

Present P.C.O. strength - 15 officers Rate of Pay $10,500/yr. & Benefits

$10,500.00X15= $157,500.00

21% of tickets issued during 1979 were for Resident parking

$157,500.00X21%-$33,075 P.C.O. Salary
Tickets $42.00/m or$2,000.00
Computer Processing 1979 $300,000.00X21%=$63,000.00

D. INCOME

During 1979. 48,293 parking tickets were issued with a $15.00 fine

32,662 for Mass. Reg.
15,631 for out of state

Assume 50% collection for Mass. tickets and 15% collection for out of state.

32,662 X 50% = 16,331 x 15.00=	$244,965.00
15,631 X 15% = 2,344 x 15.00=	35,170.00
Income/yr:	$280,135.00
Income from issuing stickers	22,500.00
	$302,635.00

E. SUMMARY

Installation Cost	$105,000.00	one time
Yearly Cost:		
Operation	39,000.00	
Enforcement	35,000.00	
Computer Time	63,000.0 (1979)	
Total yearly cost	$137,000.00	
Estimated Income	$302,600.00	
Per year net inome	165,600.00	
First year income	60,600.00	

VII. LEHIGH VALLEY PENNSYLVANIA TRANSIT SYSTEM RETRENCHMENT

I. BRIEF DESCRIPTION

This project involved the restructuring of the transit system in the Lehigh Valley by the Lehigh and Northampton Transportation Authority (LANTA). The system serves Allentown, Bethlehem, and Easton, an industrial metropolitan area of eastern Pennsylvania, and was initiated on September 5, 1977, with smaller subsequent cutbacks January 1978. There have been smaller changes since then. The project involved route restructuring to eliminate two duplicative routes and provide more direct service on others as well as elimination of runs on other routes in response to low demand. The 13.5 percent service cutback resulted in only a 2.2 percent ridership loss and gains in system productivity. Passengers carried per service hour went up 12 percent, net revenue per hour increased 35 percent and operating loss rose only 1.3 percent as opposed to 7.8 percent in the previous year. This was achieved without a fare increase. However, the transit system's revenue/cost ratio continued to decline, from 38.9 percent to 37.6 percent. Productivity on effected routes improved up to 57 percent in revenue per service hour. Of the seven basic changes made to routes, four resulted in ridership gains, three in ridership losses.

II. PROJECT BACKGROUND

LANTA

In fiscal year 1977 (LANTA's year is July 1 to June 30) the Lehigh and Northampton Transportation Authority (LANTA) made extensive reductions in service. These service reductions were necessitated by escalating costs at a time when system ridership was leveling off and the systems revenue/cost ratio was dropping to unacceptable levels. The cuts were in lightly used runs and routes and involved making route changes to eliminate duplicative service. The planning, analysis and impact of these service cutbacks made by LANTA in FY 1977 are the subject of this chapter.

LANTA had been created in March, 1972 to continue the service of the private Lehigh Valley Transit Company by the Pennsylvania counties of Lehigh and Northampton. These counties comprise a small industrial metropolitan area of the cities of Allentown, Bethlehem, Easton, and suburban communities in eastern Pennsylvania's Lehigh Valley. Being a small metropolitan area with three rather than one Central Business District (CDB), transit plays a minor role (1.4 percent of all trips) in intrametropolitan travel. Local transportation characteristics give the automobile strong travel time and convenience advantages while auto congestion and parking are minor problems, even in downtown Allentown. The two counties together had a 1970 population of 470,000 and a 1980 population of 499,000. A Joint Planning Commission (JPC) exists to act both as a county planning department separately for each county as well as the Metropolitan Planning Organization (MPO) for federal-related matters in the area. The planning and impetus for LANTA had come from the JPC. JPC's assistant director became LANTA's director. JPC has continued since the creation of LANTA as its planning and grant processing agency. LANTA represented not only a name change for Lehigh Valley Transit with the onset of public ownership, but a public mechanism to expand service by obtaining federal, state and county operating subsidies. After the LANTA takeover a 62 percent increase in bus-hours of service and a 42 percent increase in service bus-mileage were instituted. In the subsequent four years, which witnessed gains in ridership (see Table VII-1), additional route and schedule additions resulted in a 12 percent increase in bus-hour service.[1] In 1975 LANTA also took over operations of the Allentown Suburban Bus Company, providing service to outlying boroughs.

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[1] P. 34, Joint Planning Commission of Lehigh-Northampton Counties, Lehigh Valley Transit Development Program 1977-1982, Transportation System Management Element, June 1976, Lehigh Valley, Pennsylvania (hereafter: TDP 1977-1982).

TABLE VII-1

LANTA RIDESHIP, MILES AND HOURS

Year	Ridership*	% +/-	Miles**	% +/-	Hours**	% +/-
1960	7,652,100	-	-	-	-	-
1970	3,770,400	-51%	-	-	-	-
1971	3,045,700	-19%	-	-	-	-
1972	2,635,300	-13%	-	-	-	-
1973(A)	2,692,496	-	1,703,695	-	151,696	-
1974	3,685,863	+37%	1,716,499	+ 1%	149,128	- 2%
1975	3,859,097	+ 5%	1,894,453	+10%	158,978	+ 7%
1976(B)	4,360,966	+13%	2,189,663	+16%	171,713	+ 8%
1977	4,435,955	+ 2%	2,201,192	+ 1%	168,035	- 2%
1978(C)	4,331,415	- 2%	1,974,581	-10%	149,367	-11%
1979	4,632,289	+ 7%	1,986,016	+ 1%	150,035	-
1980	5,028,097	+ 9%	2,019,085	+ 2%	153,022	+ 2%

* Excludes transfer passengers.
** Includes regular route miles. Excludes charter and special bus miles.

A Lehigh Valley Transit takeover by LANTA - basis of ridership figures not similar so no precise comparison can be made.
B In this year, service was expanded to include the Slate Belt, Trexlertown, Fogelsville and Slatington with LANTA takeover of Allentown Suburban Bus Lines.
C A 13.5% reduction in service implemented in September, 1977 as an efficiency measure resulted in only a 2.2% loss in patronage.

All figures based on fiscal year: July 1 - June 30.
LVT figures based on calendar year.

The period 1972-1976 was one of growth for LANTA but two factors combined to make JPC and LANTA plan for service cutbacks in 1977: a leveling off of ridership and escalating costs (see Table VII-2). LANTA's revenue/cost ratio had dropped from .63 in 1974 to .388 in 1976. For these reasons the JPC recommended that LANTA seek ways of reducing costs by eliminating unnecessary or underutilized bus runs by rescheduling, combining some routes, and eliminating others.

Criteria for Service Cuts

Much of the rationale behind routing of buses, which LANTA employed in the service cutbacks, was outlined in the original Lehigh Valley Transit Development Program (TDP) 1977-82 developed by the Joint Planning Commision. The TDP identified several considerations for system planning:

1. Directness of routes was important as meandering, time-consuming routes cannot compete with automobiles. Directness was measured by a ratio of bus route miles to the shortest travel time highway route an automobile would take with the same points of origin and destination. It was felt this ratio should not exceed 1.5.

2. Route Spacing should be consistent with anticipated ridership based on population density and income.

3. Through Routes which pass through the Central Business Districts (CBD) and continue on to serve another radial corridor were prefered to routes which terminate in the CBD because transfers are minimized. These routes should, however, converge and have coordinated schedules to facilitate whatever transfering does take place.

4. Route Revenues/Cost should not fall below .3 (systemwide the minimum was supposed to be .4).

5. Route Coverage of the bi-county area was stressed in subsequent TDPs and route service areas were defined as corridors a quarter-mile from the bus route on either side.[1]

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[1]Joint Planning Commission, Lehigh and Northampton Counties, Lehigh Valley Transit Development Program, 1977 Update and Evaluation, Transportation System Management Element, Task III-Item 4, Unified Work Program FY 1976-77; May 1977, Lehigh Valley, Pennsylvania.

TABLE VII-2

LANTA FINANCIAL STATISTICS (Courtesy of JPC)

Year	Operating Revenue[1]	Operating Expenses[2]	Loss from Operations	% Change In Loss	% Revenue Expenses
1973	$ 726,685	$1,223,373	$ 496,688	-	59.4
1974	1,110,622	1,928,972	818,350	+64.8	57.6
1975	1,065,297	2,328,251	1,262,954	+54.3	45.8
1976	1,044,297	2,690,055	1,645,758	+30.3	38.8
1977	1,129,791	2,904,049	1,774,258	+ 7.8	38.9
1978	1,085,775	2,883,655	1,797,880	+ 1.3	37.6

[1]Excluding PennDOT grant for Senior Citizen Free Fare Program.
[2]Excludes "depreciation".

Note: Based on 1,974,581 vehicle miles for 1978, this projection represents $0.55 revenue/vehicle mile system-wide.

SOURCE: Concannon, Fronheiser, Gallagher & Miller, CPA, LANTA

JPC's Recommendations for Cuts

The Joint Planning Commission's recommendations for LANTA service cuts were contained in the 1977 update to the Transit Development Program.[1] Table VII-3 shows the revenue statistics for LANTA's routes before the cuts in early 1977. The JPC noted that three routes (8,11 and 30) failed to meet 30 percent of operating costs and four others (12, 34, 36 and 46) failed to cover 40 percent of operating costs (these revenues include Pennsylvaina Lottery funds for the senior off-peak free fare program). These routes then became prime candidates for cutback analysis. JPC's recommendations were as follows (see Map VII-1):

1. Examine service on the #8 route for possible reduction.

2. The #11 route should be eliminated and #11 riders served by realigning the #10 and #34 routes. Even without any realignment, the few #11 riders were not a long walk from the existing #10 and #34 routes.

3. More frequent service on the #26 and #27 routes would be appropriate.

4. The #30 route might be shortened and only go to Bangor and not the other Slate Belt communities. The #30 is a rural route between Easton and outlying Slate Belt communities northeast of Allentown and Bethlehem.

5. It was suggested that the Trexlertown fork of the #46 route be on a non-daily basis and the Allentown portion be taken up by the #45.

6. The #34 route service should be decreased.

7. The #12 and #35 route schedules should be better integrated.

In the process of reviewing these JPC recommendations and determining how to rationalize these with run scheduling, a number of modifications were made. While LANTA wanted to cut service, it did not want to drop area coverage of service to outlying communities. Also, some re-routing would grant more service to more potential riders without incurring extra costs. The following were the revisions to the original JPC suggestions:

1. No revision - #8 service was cut.

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[1] Ibid.

TABLE VII-3

"BEFORE" REVENUE STATISTICS FOR LANTA ROUTES

Route	Name	Total Daily Passengers[1]	Estimated Route Revenue	Daily Revenue Bus Hours[2]	Directness Ratio
1	Hanover	1,698	$481	35.47	1.09
2	22nd & Highland	448	125	14.75	1.00
3	30th & Greenleaf	544	156	16.38	1.05
4	Northampton	894	260	33.78	1.03
5	Whitehall	645	177	20.57	2.30
6	6th-9th St. Loop	639	162	13.08	1.24
8	West Gate	179	48	9.52	2.48
9	Delaware Ave.	370	101	9.42	1.48
10	Stefko Blvd.	259	68	8.32	1.24
11	Prospect Hts.	176	49	11.42	2.10
12	Hellertown	430	118	18.00	1.18
15	S. 15th St.	196	39	4.20	1.82
16	N. 15th St.	190	54	7.87	2.53
22	Easton-Bethlehem	417	105	11.00	1.24
23	College Hill	200	46	5.17	1.47
24	Freemansburg Ave.	761	186	16.50	2.03
25	Northampton St.	751	189	17.75	1.62
26	Berwick St.	307	83	5.58	1.00
27	Line St.	301	81	5.92	1.58
28	Bushkill St.	131	31	3.83	1.21
30	Easton-Bangor, Uhlers	126	33	5.33	1.89
31	Slate Belt	43	10	4.92	2.41
34	Easton Ave.	326	88	14.68	2.41
35	E. 4th St.	452	117	11.75	1.29
36	Emmaus	620	177	27.40	1.20
37	Boro Line	579	162	19.25	1.34
39	S. Bethlehem	1,212	339	28.28	1.04
43	Union Blvd.	1,326	354	32.57	1.16
44	Allen St. - Greenawald	672	183	18.87	1.11
45	South 24th St.	552	147	19.03	1.09
46	W. Allentown	292	89	15.67	1.28
49	Slatington	171	55	7.25	1.22

SOURCE: LANTA

[1]Counts taken March 30, 1977.
[2]Average fare/total passenger for March, 1977 was $.252.

2. The #11 route was eliminated and the #10 route modified extensively to pick up the #11 route area. However, the #34 route was not modified.

3. Service frequencies were not increased on the #26 and #27 routes.

4. The #30 Slate Belt route was not cut back or modified. Despite the low revenue perfomance of this route, it was felt that service to these small, outlying communities must be maintained.

5. Similarly service was not cut back on the Trexlertown fork of the #46 route. However, this segment became an extension of some #45 route trips, and the route was extensively modified.

6. #34 route service was cut.

7. LANTA chose to integrate the #12 and #35 routes by eliminating the #35 route, which ran either on the same road as the #12 route or three blocks away.

In addition, a few other modifications were planned and implemented by LANTA. These were:

8. Having more route #4 runs divert across the Lehigh River to Front Street, Coplay rather than run on the east side of the river on a straighter route. This modification allowed route #4 to reach a greater pool of transit riders in Coplay and allowed LANTA to cut back service on the #5 route, which also ran on Front Street, Coplay.

9. To meet the criteria of facilitating through trips and reducing transfer waiting time, it was decided to combine one of the Bethlehem radial routes with the strong #1 Allentown-to-Bethlehem route. The old Bethlehem downtown is a convenient transfer point. However, as it is a much smaller and economically less vital CBD compared to Allentown's, it attracts fewer riders and many riders go to the Broad and New Street transfer point in downtown Bethlehem only to transfer to go to Allentown. After an analysis of runs and scheduling problems, it was decided by LANTA to have route #12 runs continue on as route #1 runs to the Allentown CBD from Broad and New.

10. The #16 route was changed to make it more direct from its major suburban generator, Olympic Garden Apartments.

A LANTA staff review of the FY1978 budget revealed that unless costs were reduced, a "shortfall" in money available to finance operations would occur before the end of the fiscal year.[1] LANTA also was less productive as measured in revenue/cost ratio than most other small Pennsylvania transit systems (see Table VII-4).

State Transit Subsidy

A further impetus for more service cuts by LANTA was provided by the State's transit assistance program--Act 101. Section 204, Article II, "Urban Mass Transportation Assistance Law of 1967" amended) spells out minimal criteria for transit system efficiency with guidelines and limits for revenues and subsidy levels. In addition it provides financial bonuses (equal to up to 8.3 percent of constrained deficit) to systems which demonstrate improved productivity based on four transit efficiency ratios:

1. A slippage of no more than 2 percent in the system's revenue/cost ratio from the previous fiscal year. For example, a system making up 40 percent of its operating costs out of farebox revenues would be expected to meet more than 38 percent of its revenues out of farebox revenues the following year and more than 36 percent the year thereafter.

2. Higher ridership per vehicle hour in the system than in the previous year.

3. Higher operating revenue per vehicle hour in the system (adjusted for inflation) than in the previous fiscal year.

4. Lower operating costs per vehicle hour in the system (adjusted for inflation) than in the previous fiscal year.

PennDOT had a goal of getting transit systems up to a revenue/cost goal of .48, allowing for the 2 percent slippage from FY1982 on. The Act limited the State transit subsidy money any system could receive to an amount no greater than 75 percent of its operating costs less revenues and federal subsidies and provides a basic subsidy (exclusive of any incentive grant

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[1]Letter, Armando V. Greco, Executive Director, LANTA, to Samuel Smith, Delaware Valley Regional Planning Commission, November 4, 1981.

TABLE VII-4

COMPARISON OF TRANSIT SYSTEMS EFFICIENCY

Location[1]	Base Fare 76-77	Revenue÷Expenses[2] FY 76	FY 77	Change Numeric	'76-77 Percent
Erie (EMTA)	$0.35	.6323	.6212	-0.1111	- 1.8
Johnstown (CCTA)	0.45	.7970	.6191	-0.1779	-22.3
Reading (BARTA)	0.40	.5932	.5932	0.0[3]	0
Scranton (COLTS)	0.35	.6019	.5907	-0.0112	- 1.9
Wilkes-Barre (LCTA)	0.35	.6118	.5813	-0.0305	- 5.0
Harrisburg (CAT)	0.35	.6535	.5277	-0.1258	-19.2
Lehigh Valley (LANTA)	0.35	.4924	.4767	-0.0157	- 3.2
Altoona (AMTRAN)	0.40	.5594	.4686	-0.0908	-16.2
Lancaster (LCCTA)	0.45	.5709	.4394	-0.1315	-23.0
Williamsport (WILLM)	0.35	.4826	.3700	-0.1126	-23.3
TOTAL		.5997	.5426	-0.0571	- 9.5

[1]For valid comparison, this table includes only those transit system in the smaller urbanized areas of Pennsylvania.

[2]The calculation of "revenue" includes the PennDOT grant to transit systems for the Senior Citizen Free Fare Program. The operating ratio is, therefore, different from that shown in Table 3, which excludes the grant.

[3]Actualy, BARTA's ratio declined by .000058, which does not appear in the table.

SOURCE: Derived from PennDOT, Pennsylvania Mass Transit Statistical Report, 1976-1977, 1978, Tables 10, 11; p. 18, 19.

subsidy) equal to 66.7% of constrained deficit (minus revenues and federal subsidies).[1]

Regulatory Process

A help to LANTA in implementing the cuts was its own unfettered control over making route and schedule revisions. It is self-regulating, chartered under state law as a metropolitan district public transit agency with directors appointed by Lehigh and Northampton Counties (the same arrangement as with JPC), and can initiate changes with only its board's approval. It did not need the approval of state or county governments or any state agency. It did not even have to hold a public hearing on the matter (though a hearing would be mandated now by federal regulations). Because of this freedom of action and relative freedom from political influence, the cuts could be made in quick response to the operational picture.

[1] Pennsylvania Urban Mass Transportation Assistance Law of 1967 (amended, 1979) and telephone conversation, John Dockendorf, Chief, Mass Transit Assistance Division, Bureau of Mass Transit Systems, Pennsylvania Department of Transportation, to M. Cunneen, Urbitran Associates, October 27, 1981.

III. SPECIFICS OF CUTS

LANTA cut its total operating bus hours 13.5 percent by tying some routes together, altering service frequencies and adjusting schedule hours to cut more runs. The cuts which went into effect the day after Labor Day, 1977 effected ten of LANTA's 33 routes (letters relate to Map VII-1 reference point):

a. #4 Northampton - remained essentially the same but its trip diversions to Front Street, Coplay were increased to eight trips daily to make up for reduced route #5 trips to Coplay. Peak period frequency was slightly altered.

b. #8 Westgate, Bethlehem - peak period service was reduced from every 60 minutes to every 80 minutes.

c. #11 Prospect Heights, Bethlehem - this route was fused with route #10, Stefko Boulevard to form a new #10 route with service frequency about the same and only a slight loss in area coverage.

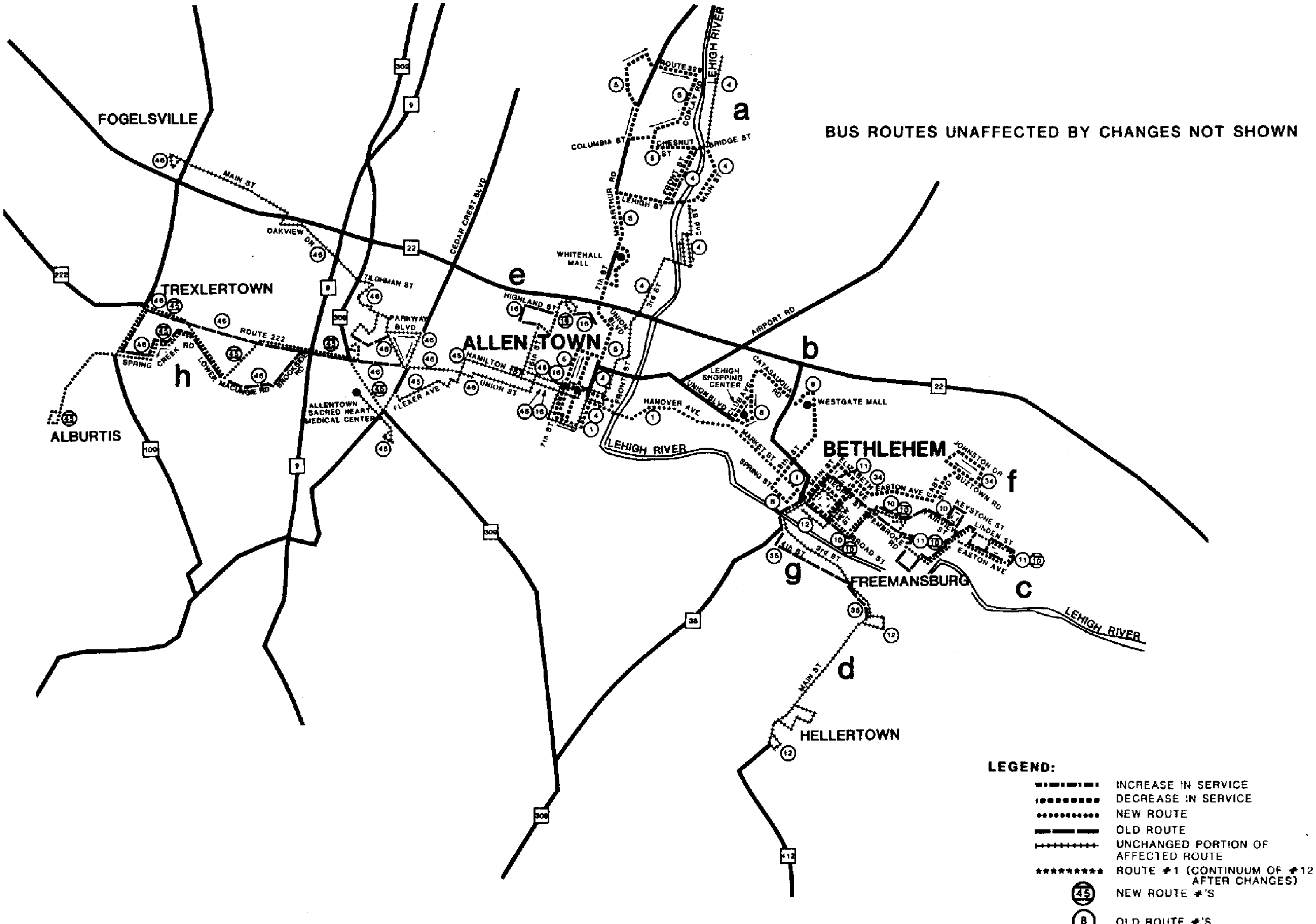
d. #12 Hellertown - was linked with route #1 Hanover Avenue. Hellertown passengers for Allentown no longer had to transfer at Broad and New Street in Bethlehem as the #12 bus now continues as the #1 on to Allentown from the Broad & New transfer point in Bethlehem. Some changes were made in the route #12 schedule. Route #12 also was to pick up additional passengers from nearby route #35, a duplicative route which was eliminated.

e. #16 North 15th Street, Allentown - was rerouted on a more direct path to the Olympic Garden Apartments with daily trips reduced from ten to eight.

f. #34 Easton Avenue, Bethlehem - service frequency was cut from every 40 minutes all day to every 60 minutes in the peak period and every two hours off-peak.

g. The #35 East Fourth Street route was eliminated as it duplicated route #12.

h. #45 South 24th Street, Allentown - was extended to take over the Trexlertown fork of route #46 at the same service frequency with some adjustment to the number of off-peak trips. This new extension of the #45 route to Trexlertown, west of Allentown, was on a somewhat modified version of the old #46 route and was further extended southwest to Alburtis.



Map VII-1: LANTA CHANGES TO BUS ROUTES, SEPTEMBER 1977

IV. IMPACT OF CUTS

The cuts meant a 13.5 percent reduction in service hours and an annual reduction in scheduled bus miles from 2.2 million to 1.9 million. (At a conservative estimate of four miles per gallon per bus, this would equate to a diesel fuel savings of 75,000 gallons annually.) The number of LANTA's routes were cut from 33 to 31 as the #11 and #35 routes were eliminated. Thirteen drivers were laid off (all were later rehired). The dropping of 13 drivers represented a large labor savings; LANTA in 1981 was employing only 91 drivers and 41 other employees.

In fiscal year 1978, productivity in terms of passengers carried per hour was up 12 percent over FY1977. While service was cut 13.5 percent, ridership declined only 2.2 percent.[1] More importantly the increase in operating loss increased only 1.3 percent in FY1978 as opposed to 7.8 percent in FY1977. However, despite the containment of costs, LANTA's revenue/cost ratio still declined from 38.9 percent to 37.6 percent and was lower than six out of ten small Pennsylvania transit systems (see Table VII-5).[2]

Aside from the systemwide performance, which saw a 7.7 percent increase in revenue per hour, an analysis of the affected routes indicates most had better performance after the changes went into effect (see Table VII-6). The particular ridership and revenue-per-service hour changes are as follows (letters relate to Map VII-1 reference points):

a. While combined route #4/5 ridership remained about the same, fewer bus runs were required to serve it, resulting in more productive use of the buses and greater revenue per hour. In effect the "before" condition had some runs of the #5 duplicating #4 runs.

b. Despite the cut in service on the #8 Westgate route, ridership increased. With fewer runs carrying more riders, the productivity of the buses increased 47 percent (measured in revenue per service hour).

c. The combination of the #10 and #11 routes into a new and realigned #10 Stefko route with most runs on to Prospect Heights also worked out successfully. Ridership on the new #10 route was actually 22.3 percent higher than on the old #10 and #11 routes combined. With the reduction in total bus runs and mileage and greater ridership on this corridor, bus productivity (revenue per hour) grew 13.9 percent on the Prospect

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[1]Letter, Greco to Smith.
[2]1978 Update, Lehigh Valley Transit Development Program, JPC, March 1978.

TABLE VII-5

COMPARISON OF SMALL PENNSYLVANIA
TRANSIT SYTEMS EFFICIENCY, 1978

Location	% Revenue/Expenses
Johnstown (CCTA)	.58
Harrisburg (CAT)	.50
Erie (EMTA)	.61
Wilkes-Barre (LCTA)	.57
Reading (BARTA)	.63
Scranton (COLTS	.50
Lancaster (LCCTA)	.46
Lehigh Valley (LANTA)	.46
Williamsport (WILLM)	.35
York	.46
Altoona (AMTRAN)	.39
Systems Average	.52

Note: The ratio shown above is higher than the .366 ratio for LANTA given in the text because it includes as "revenue" the reimbursement for senior citizens free rides from the Pennsylvania Lottery.

SOURCE: Pennsylvania Department of Transportation, Pennsylvania Pennsylvania Mass Transit Statistical Report, 1978.

TABLE VII-6

INDIVIDUAL ROUTE PERFORMANCE
(Lefthand letters relate to Map VII-1 references of changes)

	Route	Name	Total Daily Passengers (A) FY1977	FY1978	% Change In Revenue Per Hour
(a)	4	Northampton	894	987	21.8
	5	Whitehall	645	639	18.4
(b)	8	Westgate	179	236	47.0
(c)	10(11)	Stefko & Prospect Hts.	435(B)	337	13.9 Prospect Hts. 56.8 Stefko Blvd.
(d,g)	12(35)	Hellertown	882	560	28.7
	1	Hanover	1,698	1,719	4.6
	39	S. Bethlehem	1,212	1,199	-3.8
(e)	16	N. 15th St.	190	143	36.4
(f)	34	Easton Ave.	326	170	37.7
(h)	45(46)	S. 24th St.	552	525	1.9
	46	W. Allentown	292	241	24.6

(A) Derived from system-wide counts taken by LANTA over a two-day period.
(B) Combined ridership, Routes 10 and 11.

SOURCE: Table 5, Joint Planning Commission, 1978 Update, Lehigh Valley Transit Development Program, A Transportation System Management Element, March 1978 and similar 1977 Update.

Heights portion and 56.8 percent on the Stefko Boulevard portion.

d,g. The #35 East Fourth Street route from South Bethlehem to downtown Bethlehem was eliminated because it duplicated the #12 Hellertown route to the Bethlehem CBD. The #12 route was never more than three blocks from the #35 route and shared a common route with the #35 for almost half its length. The #39 route to the Allentown CBD also used East Fourth Street as the #35 route did. In addition, by having #12 buses to the Bethlehem CBD continue on as #1 buses to the Allentown CBD, the composite effect of the changes was to give former #35 route riders a choice of two through routes to Allentown within walking distance, one north (#12/#1) and one south (#39) of the Lehigh River.

Despite the strong logic for eliminating the #35 route, this change saved costs but apparently did so at the loss of some ridership, though other factors may account for this. Revenue per hour grew 28.7 percent on the #12 route but FY1978 ridership was only 560, less than the 882 ridership of the #12 and #35 routes combined. Nor did #35 route riders switch to route #39; ridership on the #39 dropped slightly and its revenue per hour declined 3.8 percent.

f. The cutback in service on the #34 route produced similar results--both costs and ridership went down. Yet the productivity of the route, as with the #12 route, was better by 37.7 percent.

h. The shifting of the #46 route to Trexlertown as a continuation of some #45 trips also improved productivity but entailed a slight ridership decrease, which may have been unrelated given the service maintained.

In summary, the changes yielded greater productivity and delivered more useful service per cost though in a few cases may have lost ridership. The three cases in which service runs or mileage were cut but ridership actually increased are evidence of good planning and also underscore that some of the fluctuations in ridership were unrelated to the service offered.

Despite these and subsequent cuts, LANTA has continued to lag behind small Pennsylvania transit systems in overall productivity, as characterized by revenue/cost ratio (see Table VII- 5). LANTA was also still offering much more service (in operating bus hours) than in 1972. Even in 1981, after some additional changes, LANTA was offering about 30 percent more service than what it had inherited in 1972 from Lehigh Valley

Transit.[1] Qualitatively the service may also be slightly better through better timed transferring, more through routes, better information and some passenger amenities.

Had there been no 1977 cuts, revenues would probably have been about the same with costs about 10 percent higher. However, the Executive Director of LANTA is now concerned that additional cuts will decrease ridership in direct relation to the reduction of service instead of the 13 percent cuts/2 percent ridership decrease situation in 1977. This suggests that LANTA in 1977 winnowed out its most unproductive runs and additional cuts will occur past a point of diminishing returns and depress ridership. The possible exceptions to this rule are LANTA's routes to outlying boroughs (#12, 30, 36, 45, 40 and 49) which are low revenue-to-cost performers and could be cut without great loss in riders.

Percentage ridership losses in almost direct proportion to percentage of cuts have already been experienced by LANTA in its most recent cutbacks. For these reasons rather than continue cutting service, LANTA has instead raised fares since 1977. When LANTA began in 1972 fares were 45¢ and were reduced to 35¢ in 1975. No increase in fares was instituted by LANTA from 1975 to July 1979, when basic fares rose by a nickel from 35¢ to 40¢. In July 1980 the fare was raised to 50¢. The 5¢ transfer charge has not been changed. Also off-peak fares remain at 40¢. Discounted 10 and 40 ticket books and unlimited ride monthly passes ($17.00) are available. Off-peak senior fares are free, covered by revenues from the Pennsylvania State Lottery.

Tables VII-7 and VII-8 from JPC's 1979 Update to the TDP indicate the continual fiscal problems with some of LANTA's routes, including some (#8, 10, 12, 34, 45 and 46) which underwent substantial revision in 1977 or thereafter and the #30 Slate Belt route which JPC had suggested be cut back in 1977. Should federal transit subsidies (33 percent of LANTA's 1979 revenue) be phased out and state or county subsidies not increase to replace the federal funds, LANTA would probably be forced to substantially reduce service and another process similar to the major changes in 1977 would take place. LANTA, by having already made these kinds of cuts and by continually monitoring route performance in conjunction with JPC has at least a good basis on which to make such an adjustment.

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[1] Armando Greco to M. Cunneen, November 1981.

TABLE VII-7
REVENUE/COST RATIOS (Per Hour), 1977-1979

		FY1977[1]	FY1978[2]	FY1979[3]	Pattern[4]
1	Hanover Avenue	80.2	74.7	66.3	1
2	22nd Street	50.3	42.2	35.1	2
3	30th Street	56.4	47.7	47.7	3
4	Northampton	45.6	49.4	45.7	3
5	Whitehall	50.7	53.5	43.3	3
6	6th-9th St. Loop	73.4	71.5	64.9	1
8	Westgate	29.7	38.9	28.0	4
9	Delaware Avenue	63.1	52.1	45.0	5
10(pt)	Stefko Blvd.	48.4	67.6	49.7	3
10(pt)	Prospect Heights	25.2	25.5	33.1	6
12	Hellertown	38.8	44.4	36.4	4
15	S. 15th Street	55.1	56.4	53.6	3
16	N. 15th Street	40.6	49.3	47.7	3
22	Easton-Bethlehem	56.7	50.0	39.6	2
23	College Hill	52.1	49.9	43.8	2
24(pt)	Stone's Crossing	69.8	44.1	33.7	2
24(pt)	West Easton	58.1	48.3	37.7	2
25(pt)	Seipsville	56.3	74.0	54.8	3
25(pt)	Northampton St.	75.1	54.1	48.1	5
26	Berwick St.	87.9	74.9	65.9	1
27	Line Street	80.8	74.4	63.8	1
28	Bushkill Street	48.5	45.1	30.3	2
30(pt)	Easton-Bangor	36.6	29.3	27.9	2
30(pt)	Slate Belt	11.6	13.5	16.6	2
34(pt)	Easton Avenue	35.5	43.5	27.5	4
34(pt)	E. 4th Street	59.0	43.5	51.9	3
36	Emmaus	38.2	35.3	35.9	4
37	Boro Line	49.8	51.3	46.5	3
39	South Bethlehem	70.7	60.6	54.1	5
43	Union Boulevard	64.2	60.3	51.9	5
44	Greenawalds	57.2	45.4	44.0	5
45(pt)	S. 24th Street	45.7	51.9	42.8	2
45(pt)	Trexlertown	45.7	36.6	31.5	2
46	W. Allentown	33.7	37.4	32.9	4
49	Slatington	44.6	26.6	34.2	4
Allentown Division		52.8	51.3	45.7	2
Easton Division		59.4	53.3	43.5	2
TOTAL		53.8	51.7	45.3	2

[1]Cost per hour: $16.92 - Data collected March 30, 1977.
[2]Cost per hour: $18.99 - Data collected November 15-16, 1977.
[3]Cost per hour: $20.73 - Data collected Octobert 17-18, 1987.
[4]See Table VII-8.

SOURCE: LANTA, JPC.

TABLE VII-8

FINANCIAL PATTERNS OF LANTA ROUTES

Pattern of movement of route's ratio of revenue per hour/cost per hour, FY 1977 - FY 1979	Route to which pattern applies
1 - Ratio is at a high level, but is declining	1, 6, 26, 27
2 - Ratio is dropping, approaching or below 40%	2, 22, 23, 24, 28, 30, 45
3 - Ratio is acceptable and holding steady	3, 4, 5, 10 (Stefko), 15, 16, 25 (Seipsville), 34 (E. 4th. St.), 37
4 - Ratio fluctuates below 40%	8, 12, 34 (Easton Avenue), 36, 46, 49
5 - Ratio is at an acceptable level, but is declining	9, 25 (Northampton St.), 39, 43, 44
6 - Ratio is rising steadily	10 (Prospect Heights)

The minimum acceptable ratio used in this analysis is 40% since this is the systemwide objective. This permits identification of those routes which are pulling down the systemwide ratio even though they may meet the individual route objective of 30%.

SOURCE: JPC

VIII. SEATTLE METRO PART-TIME BUS OPERATOR PROGRAM CASE STUDY

I. BACKGROUND INFORMATION

A. Introduction

The use of part-time bus operators has become an important labor relations issue at transit systems around the country. While Seattle Metro employs the largest number of part-time operators, other transit properties (notably Washington, D.C., Baltimore, and Minneapolis/St. Paul) are using part-time drivers to provide expanded peak hour service. The management of Seattle Metro felt that use of part-time drivers would increase labor productivity, and reduce the cost of providing more peak hour service on heavily patronized commuter routes. Cost savings realized by paying part-time drivers only for work in rush hour periods (instead of the eight hours pay guaranteed for full time drivers regardless of the amount of time worked), could be used to provide more service and increase ridership in off-peak periods. However, transit labor felt that hiring part-time drivers would threaten the jobs and pay (especially overtime) of the full time drivers, would dilute the union's bargaining strength, and would result in higher labor costs in the long run. Since the use of part-time operators by transit systems has started only recently, it is not clear whether cost savings or productivity gains anticipated will actually materialize. Based on Seattle Metro's experience since 1977, parttime drivers will reduce labor costs to a small degree initially because they are only guaranteed a minimum of one and one half hours pay per shift. But use of part-time drivers has met with opposition from fulltime drivers, who have demanded (and received) pay and work rule concessions that may limit productivity gains and eliminate any labor cost savings in the long run.

B. Seattle Metro - Institutional Background

Metro Transit is a division of the Municipality of Metropolitan Seattle which provides transit services in King County and to cities in adjacent counties by contract. It operates 75,000 miles of weekday service over 120 routes, using 536 buses and 59 trolley coaches. The system has about 1,800 employees and carries over 40 million revenue passengers per year.[1] Fare policies and operating plans must be approved by the Metro Council,[2] a 36 member board made up of elected and

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[1] Transit System Productivity, Urban Consortium, June 1978, p. 13.

[2] The Metro Council includes all of the members of the Seattle City Council and of the King County Council, as well as the Mayor of Seattle and the King County Executive.

appointed officials from local governments, which is the governing body of the Municipality of Metropolitan Seattle.

After assuming responsibility for transit operations in the Seattle urban area in 1973, Seattle Metro rapidly increased service and initiated an ambitious marketing program with a goal of increasing ridership to 60 million in 1980. Between 1973 and 1976, patronage grew from 32.4 million riders to 41.8 million riders, an increase of 29 percent.[1] However, over the same three year period there were large increases in transit operating costs (mainly for labor and diesel fuel), and in 1976 Metro's operating costs were increasing at three percent above the yearly overall rate of inflation. Despite a relatively secure funding base, including a one per cent vehicle excise tax (30% of total revenues) and a sales tax of 3/10 of 1 percent in King County (40 percent of total revenues), if costs continued to escalate more rapidly than revenues, Metro faced an estimated $10 million operating deficit in 1980 and a $27 million deficit in 1983.[2] It was clear that unless operating costs could be controlled, revenues from fares (about 30 percent of total revenues) and funds available from local taxes and UMTA Section 5 would be increasingly inadequate to sustain Metro's operations.

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[1] Transit System Productivity, Urban Consortium, July 1978, p. 13.

[2] Mass Transit, December 1979, p. 17.

II. PROGRAM PLANNING

A. Adoption of Part-Time Driver Proposal

With the prospect of imminent financial difficulties, in 1977 Seattle Metro developed a program designed to meet the 1980 patronage goal while limiting the rate of increase in operating costs to the projected annual inflation rate of 6 percent. This cost control strategy included an expanded marketing program, driver performance and service quality standards, a management-by-objectives budgeting system, and changes in work rules and staffing requirements. This program was partly the result of a 1976 marketing survey, which indicated that the off-peak market was largely saturated, implying that to increase patronage, Metro should increase its peak period service. Charles Collins, director of transit operations at Seattle Metro, commented: "It became clear to us that we were not going to reach our ridership goals (56.6 million trips by 1981 as opposed to 43.7 million in 1977) by increasing our off-peak ridership...obviously, we had to go after rush-hour riders in a way that wouldn't destroy the system financially."[1]

An examination of Metro's operations revealed that a substantial amount of poorly utilized off-peak service was being provided in order to occupy full-time drivers who were guaranteed eight hours' pay even if they worked only during peak hours. Metro also noticed that it was operating twice as many buses at rush hour as during non-peak periods, and that the disparity would be even greater by 1980, when they hoped to have nearly 700 buses in peak hour service with no increase in off-peak service. Since bus operator labor expenses account for about 55 percent of Metro's operating costs, in management's view improving labor productivity was essential to control costs.

Given that increases in off-peak ridership were likely to be difficult to achieve, and that use of operators who worked only during rush hour but were paid for a full day was correctly judged inefficient, Metro management made several important decisions. First, rather than emphasizing marketing programs aimed at increasing off-peak ridership substantially, Metro decided to improve rush-hour service. Specifically, Metro planned to shift 100,000 bus hours of service from off-peak to peak periods.[2] However, this service reallocation would not be financially possible with full-time drivers paid for eight hours but needed only for the morning and evening rush hours, as this would lead to an even greater escalation of costs relative to revenues. Secondly, Metro decided to investigate the

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[1] _MT_, January/February 1979, p. 103.
[2] _MT_, December 1979, p. 17.

use of part-time bus drivers to increase peak period service while controlling costs. Metro's contract (1974) with the Amalgamated Transit Union guaranteed each driver eight hours of pay regardless of the hours actually worked. Metro personnel manager Susan Pavlou asserted that "the 40 hour work week is essentially incompatible with peak service demands," and summed up management's attitude in the following statement:

> "In the final analysis, the issue was a major question of public policy: would the demands for increasing guarantees to our operators and more restrictive work rules determine the amount and quality of transit service in King County or would elected and appointed officials make those decisions."[1]

Realizing that work rules are a major determinant of labor and overall operating costs, and that the 1980 ridership goals were probably unattainable with the existing (1974) labor contract, in early 1977 Metro began a series of studies of the contract, due to expire on October 31, 1977. Work rule options were identified, analyzed, and costed out in order to prepare for contract negotiations. An internal Seattle Metro report projected cost savings of $2,654,000 in 1978, $3,440,000 in 1979, and $4,584,000 in 1980 if the part-time driver program was implemented, which would result in a small operating surplus during those years. Deficits of $2,560,000 in 1978, $2,709,000 in 1979, and $4,281,000 in 1980 were forecast if the part-time driver program was not adopted.[1] In April 1977, Metro management concluded that the most effective way of holding down the escalation of operating costs was to use part-time drivers to provide rush hour service. Another option being considered when this decision was reached would have eliminated the eight hour pay guarantee in the 1974 contract. Management's decision was accepted by the Metro Council in May, 1977, when it adopted a 1980 budget based explicitly on the use of part-time drivers during peak periods.

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[1] MT, December 1979, p. 17.
[2] Table IV, "The Need For Part-Time Drivers," Seattle Metro, April 1977.

III. PART-TIME OPERATOR PROGRAM - OBJECTIVES, NEGOTIATION, IMPLEMENTATION

A. Objectives

Seattle Metro's objectives in seeking work rule changes to allow the use of part-time drivers were twofold. First, Metro felt that securing the right to use part-time drivers in peak periods was necessary to control operating cost increases and improve labor productivity. Second, use of part-time drivers in peak periods would allow Metro to expand rush hour service in order to reach its patronage goals at minimum cost.

Division 587 of the Amalgamated Transit Union (ATU) had several concerns about the use of part-time drivers. First, the union felt that employment of part-time drivers threatened the jobs, benefits, and pay (especially overtime in peak hours) of full-time drivers, who are all union members. ATU members also felt that employment of part-time operators, who would be required to join the ATU (Seattle Metro is a union shop), might create internal conflicts within the local due to differences in interests and outlook between part-time and full-time operators. Union local members also feared that such divisions might undermine unity and weaken the bargaining position of the union. Other union concerns included possible safely hazards arising from the use of drivers with limited training and work experience, and public relations problems with using drivers who were unfamiliar with the transit system and might not be able to provide proper assistance to passengers.

Union leaders also questioned whether the savings anticipated from the use of part-time drivers would in fact be realized. These savings, they contended, would be exceeded by additional costs of training part-time drivers since they anticipated a high rate of turnover. Most important, as later events demonstrated, the union had no intention of allowing part-time drivers to replace full-time drivers except on a temporary basis, and then only if substitute full-time drivers were not available. The ATU stood firmly behind demands for labor protection provisions which would guarantee a minimum number of full-time operator positions, thus insuring that vacancies created by attrition among full-time drivers would not be filled by part-time drivers. Finally, the union argued that cost savings would be minimal not only because of minimum full-time labor requirements, but also because part-time drivers would be represented by the ATU in grievance arbitration procedures and in the 1980 contract negotiations, when they would receive union backing for increased guarantees and benefits. Given the limitations imposed by the union on the use of part-time drivers, it is reasonable to expect that the cost savings attributable to the program would be diminished considerably.

B. Contract Negotiations

Negotiations to renew the contract due to expire at the end of October 1977 began on September 1st. The major issue which arose and which prevented early agreement was Metro's proposal to use part-time operators. Metro entered negotiations seeking the right to hire part-time drivers as a non-negotiable management demand. To soften union resistance to the proposal, Metro made clear that it did not intend to dismiss full-time drivers to make room for part-time drivers or to reduce full timers to part-time status. This stance made the idea easier to sell to the ATU because existing union members were not threatened. Nevertheless, Metro was prepared for a strike, if necessary, to gain acceptance for the part-time driver program. As one Metro official stated, "we decided that we were willing to take a strike, because in the long run our riders would be better off."

During the negotiations, which lasted from September 1977 to January 1978, Metro officials refused to discuss the union's wage and benefit demands until the part-time driver issue was resolved. Metro insisted that they would not be able to determine how much money would be available for wages and benefits until they knew how many full-time drivers would be employed. Meanwhile, the Seattle City Council adopted and funded a contingency plan providing for carpooling assistance, relaxed downtown parking restrictions, and fringe lot parking with shuttle bus service downtown in the event of a transit strike.

While union leaders initially refused any compromise on the part-time drivers issue, their attitude gradually changed for a number of reasons. First, Metro was willing to grant the existing union members an acceptable wage and benefits package; the part-time driver issue was the only major barrier to agreement. On November 3, ATU Division 587 Business Agent John Senear reportedly told members that Metro had given the union "nearly everthing it has asked for, except they want us to accept part-time employees, which we cannot do."[1] Second, union support for a strike was far from overwhelming. While a vote on November 14th authorized a strike, a complete shutdown never occurred, with most job actions taking the form of slowdowns or sick-outs which disrupted system operations but did not paralyze them. Union leaders admitted that they could not control their membership and did not have adequate discipline to run an effective strike, even if sanctioned by the international. In December, ATU Division 587 President Wendell Duncan was quoted as saying "we want to avoid a strike at all costs" in a Seattle Post-Intelligencer article which also

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[1] Transit System Productivity, Urban Consortium, p. 41.

expressed the opinion that "an early settlement appears remote."[1]

Metro linked its demands to other contract benefits. Metro Council Chairman C. Carey Donworth told a press conference in December that the economic benefits which had been negotiated for the union were not affordable unless the use of of part-time drivers was sanctioned. Finally, a nearly total shutdown of the system during a union meeting on December 19 led Metro to threatened disciplinary action against the drivers, since strikes by transit workers are illegal in Seattle. When it became clear that Metro was willing to take a strike and to take disciplinary action against the ATU if necessary, a tentative agreement was reached with the aid of a Federal mediator, which included provisions for the use of part-time drivers during peak hours (6:30-9:00 a.m. and 3:30-6:30 p.m.), under certain conditions. This agreement was ratified by the union membership in early January, 1978 by a narrow margin (725 for, 606 against), with some drivers calling for the Division 587 Business Agent's resignation.[2] Thus the union's apparent lack of strong support for a complete or long-lasting shutdown of the system, as well as Metro's wage and job security offers and the threat of legal action led to a compromise on the part-time drivers issue.

C. The Contract Agreement - Provisions

1. Wages and Benefits

Major features of the final 3-year agreement included:

1. A six percent increase in hourly rates for all job classifications, retroactive to November 1, 1977. This increased the top step for transit operators from $7.55 to $8.00/hour.

2. Cost of living increases, to be computed semiannually and applied to the base wage on November 1, 1977, for each step of the job classification. The minimum increase is two percent; there is no maximum.

3. There are additional hourly-rate increases for specified job classifications.

4. A $.50/hour premium for driving an articulated bus was agreed to, provided that the driver has not had more than two preventable accidents while driving an articulated bus during the preceding six months.

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[1] Ibid., p.42.
[2] Transit Productivity, Urban Consortium, p. 43.

5. First-day sick leave coverage, replacing a two-day waiting period.

6. Five-day increases in vacation time after 10 and 30 years of service.

7. Provision for the use of part-time drivers.

8. A provision that runs and trippers on a single line may be operated out of different bases.[1]

9. A provision that trippers operating out of the same base must be combined into a run if it is possible to do so and create an assignment of more than 7 hours and 11 minutes within a 12 1/2 hour spread. (This provision is intended to combine trippers, which can be assigned to part-time operators, into runs, which cannot, thus insuring maximum available work for full-time drivers).

2. Labor Protection Provisions

The contract provides specific protection to full-time drivers with provisions which are only effective when tripper operators are employed. These include:

1. A floor of 900 in the number of full-time drivers.

2. The number of regular and extraboard operators will always exceed the number of tripper operators.

3. Metro Transit agreed to make any reduction in the then current number of full-time drivers (1,150) by voluntary attrition and to hire at least 100 new full-time drivers during the three year duration of the contract.
4. Metro Transit agreed to maintain the number of runs that were posted and subject to driver selection on November 1, 1977, for assignment to full-time drivers. Up to 10 percent of this work may be discontinued in the event of low ridership or revenue.
5. Metro Transit agreed to maintain the level of overtime trippers available to full-time drivers (60 at the

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[1]A run is defined as straight-through work or combinations of not more than three pieces of work that exceed a total of 7 hours 11 minutes during a 12 1/2 hour spread. A tripper is defined as an assignment of less than 7 hours and 11 minutes; part-time drivers are only allowed to work trippers, and only after all full-time drivers have declined offers for them. A tripper operator is a part-time operator.

time), and to increase their number by 10 percent in 1978 and 10 percent in 1979.

6. A guarantee that full-time drivers would not be required to accept tripper operator status, nor would full-time drivers be laid off until all tripper (part-time) operators have been laid off.

7. Reservation of certain work to full-time drivers:
   - Reports: Since there is no extraboard[1] for tripper operators, all work left vacant by the absence of either full-time or part-time drivers is reserved for full-time drivers.
   - All specials, leases and vacation reliefs will be worked by full-time operators.

8. The number of all regular runs, frag runs and combos[2] in effect November 1, 1977, cannot be reduced by the hiring of part-time operators. Metro agreed not to change, eliminate or alter such runs to give tripper operators more work.

9. Tripper operators are required to become members of the ATU (Metro Transit is a union shop).

D. <u>Provisions Regulating Tripper Operators (Part-Time Drivers)</u>

A tripper operator is defined by the contract as "a person who is employed by Metro on a continuing basis whose regularly scheduled assignment shall be trippers and who will be guaranteed one and one half (1 1/2) hours straight time pay or actual hours worked, whichever is greater, for each tripper worked." The agreement stipulates that tripper operators

- Will be assigned by Metro to a specific tripper; part-time operators are limited to working one tripper per day.

- Will not work on Saturdays, Sundays, or holidays.

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[1] Extraboard refers to the group of operators responsible for covering runs left open by sick or absent regular drivers. The extraboard also covers runs left open by drivers on vacation, and charter runs.

[2] A frag run is a run slightly under the contractually specified minimum duration of seven hours, 11 minutes. A combo is a run longer than 7 hours, 11 minutes which is split into two or three pieces, but is within the 12-1/2 hour maximum spread time (i.e., a run over 12-1/2 hours in duration cannot be assigned to a full-time driver).

- Will serve a probationary period of 1,044 work hours (equivalent to six months full-time work).

- Will be paid at the same hourly rates, including step increases, as regular drivers.

- Is eligible only for limited benefits:

  - Transit system pass.
  - Social security coverage.
  - Standard uniform allowance.
  - Retirement, if eligible under State law.

(These provisions do not apply to a pre-existing category of part-time drivers called "D Board" drivers, which consists of drivers with one or more years of continuous service who want to attend school. Group D drivers earn regular rates of pay, without fringe benefits, vacations or guarantees, work at least five days a week, and work on weekday trippers only but can be used on Saturdays, Sundays, and holidays provided that all full-time operators will have perference over them in work assignments.)

While the contract allows Metro to use part-time bus drivers, the labor protection provisions effectively limit the number of part-time drivers who can be employed, and the amount and type of work that they are permitted to do. Part-time operators are only allowed to work trippers, relatively short assignments (average 2 hours, 20 minutes) during peak hours, and are allowed to work only after all full-time drivers have declined these assignments. Certain work (such as charters and vacation relief) was reserved for full-time drivers, and Metro was not allowed to alter or eliminate runs to provide more work for part-time operators who are limited to one tripper per day.[1] These restrictions on the use of part-time labor, which are fairly common for transit systems in the U.S., substantially limit the labor cost savings potential of such programs.

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[1]While Metro was not allowed to alter runs existing at the time of the negotiations, it was able to schedule most of the new peak-hour service as trippers, which were assigned to part-time drivers. Increasing the number of trippers allowed increased utilization of part-time drivers for work which would have formerly been assigned as combos or frag runs to full-time drivers.

D. Program Implementation

1. Program Expansion

As of 1978, Seattle Metro had about 280 trippers, averaging 2 hours and 20 minutes of work each.[1] Sixty of these, as required by the contract, went out as overtime to full-time drivers. The rest could be assigned to part-time tripper operators. By December 1978 Seattle Metro had hired 176 part-time operators; of these, 81 worked during the morning peak period 6:30-9:00 A.M. and 95 during the afternoon peak period (3:30 -6:30 P.M.)

During 1979, the number of part-time operators increased to 305. As of January 31, 1980, Seattle Metro had 1,260 weekday trip assignments (i.e, total pieces of work available for drivers in providing scheduled services). Of these, a maximum of 36 percent (454 peak-hour trippers) could utilize part-time operators under the 1978 contract. Three hundred and seventeen part-time operators were used to cover 315 assignments (about 25 percent of the total). By April 1981, there were 634 part-time operators comprising about 33 percent of the total number of operators (1,903). These part-time operators covered 775 trippers, about one half of total weekday pieces of work (1,541). This was the maximum possible share of pieces of work that could be assigned to the part-time driver program under the existing contract. After contract negotiations during 1981 assured continuation of the part-time driver program, the number of part-time drivers reached 812 as of January, 1982.

2. Part-Time Driver Selection and Training

By mid-February 1978, Metro had received about 500 applications for part-time work. From those passing the standard Chicago test for transit drivers, Metro hoped to hire between 200 and 300 part-time drivers by the end of 1978. This hiring goal was not met, but not because of training problems or high turnover, as the ATU had warned. Charles Collins, former transit director at Seattle Metro, explained that "we (Metro) had hoped to have 280 part-time drivers on the road by the end of 1978, and it looks like it will be more like 180. However, our experience has been good so far. Our accident rate and turnover rate with part-timers has been comparable or better than that of full timers."[2]

As the part-time operator program progressed, Metro found that the best candidates for part-time employment were teachers, off-duty policemen, and housewives. Based on Metro's

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[1] Transit System Productivity, Urban Consortium, p. 18.
[2] Mass Transit, January/February 1979, p. 103

experience with Group D employees, students are not the most desirable candidates, because their work has to be arranged around class and exam schedules. Off-duty firemen also could not be used because their tours of duty rotate between day and night shifts. One problem that arose is that there is substantially more demand for afternoon work than for morning work.[1] However, the increase in peak hour service provided over the 1977-1981 period has sustantially increased work available for part-time operators and provided more flexibility in scheduling work shifts.

Based on its hiring experience, Metro has refined its procedures for recruiting, hiring, and training part-time tripper operators. Table VIII-1 outlines current selection procedures. An expanded informational bulletin and a new application have been developed, emphasizing the negative aspects of working conditions. All applicants also must provide a narrative statement explaining their reasons for seeking part-time employment. These measures are intended to discourage casual applicants, in order to reduce turnover. However, Metro does advertise these positions.

Table VIII-2 presents some of the methods Seattle Metro has used to attract suitable applicants for part-time driver positions, although it is not clear which of these have been most effective. Once selected, all part-time drivers must complete a 19 day training course, similar to the 26 day courses given for full-time drivers, but including considerably less road coach practice and training on actual routes.

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[1]Urban Consortium, p. 18.

TABLE VIII-1
SEATTLE METRO PART-TIME BUS OPERATOR PROGRAM

Current Selection Procedures

Step 1: Self-Screening

- o Expanding informational bulletin emphasizes negative aspects of work
- o New application reinforces negative aspects of working conditions
- o Discourages casual applicants

Step 2: Applicants provide narrative statement on "Why I want to be a transit operator?"

Step 3: Interview and Evaluation

- o Screened against established attendance and tardiness standards
- o Interviewers probe ability and willingness to adhere to Metro standards and working conditions
- o Analysis on narrative statement
- o Review of driving record
- o Medical examination
- o Stability of employment record
- o Course of study and school grades

SOURCE: Seattle Metro, April 1981

TABLE VIII-2
SEATTLE METRO PART-TIME BUS OPERATOR PROGRAM

Recruitment Efforts for Part-Time Transit Operators

- o Newspaper advertisements
- o Recruitment posters
- o On-site recruitment at local colleges and universities
- o Printed job announcements
- o Telephone "Hotline"
- o Mail distribution of recruitment material to public agencies

SOURCE: Seattle Metro, April 1981

IV. PROGRAM IMPACT

A. Performance of Part-Time Drivers

1. Operational

Overall, the performance of part-time drivers as measured by absenteeism, accidents, complaints, percent completing training, and turnover has generally been as good or better than that of full-time operators. As of January 1980, of 660 trainees hired, 479 (71.3 percent) had successfully completed training and qualified as permanent part-time transit operators. This compares favorably with the 80 percent completion of training rate for full-time operator trainees. Thirty-four part-time drivers were rehired from previous full-time positions, with little retraining needed. Of these 513 part-time drivers, three have retired, 64 resigned and 32 were terminated, for a turnover rate of 19.3 percent. Ninety-four (18 percent) became full-time drivers and three took other full-time jobs at Metro, for a total program turnover rate of 38.3 percent.[1]

Between January 1978 and February 1979, attrition (excluding movement within Metro) was 13.7 percent for full-time operators and 17.9 percent for part-time operators; if promotions and transfers within Metro are included, the turnover rate for full-time drivers was 16.6 percent compared to 29,7 percent for part-time drivers.[2] In terms of turnover excluding movement within Metro, there is little difference between full-time and part-time drivers. If movement within Metro is included, turnover for part-time drivers was higher mainly because about 18 percent moved to other jobs at Metro. The high turnover predicted among part-time drivers by critics of the program has not materialized, indicating that Metro's selection and training procedures have been successful.

Attendance records indicate that part-time drivers are considerably more reliable than transit operators generally. During 1979, part-time drivers on average used 1.6 days of sick leave, while the average for all drivers was 11.5 days. Full-time operators averaged 2.6 misses and late reports, while part-time drivers averaged only .7 misses and late reports.[3] Part-time drivers have a much lower rate of absenteeism mainly because many of them are still in their probationary period of 1,044 driving hours. Full-time drivers complete this period in about six months, but part-timers working only a few hours a day require at least one and a half years to complete this probationary period.

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[1] Seattle Metro, Office of Base Operations
[2] Ibid.
[3] Ibid.

However, the presence of part-time drivers has also had a beneficial impact on absenteeism of regular drivers. Since the part-time driver program began, sick days per operator per year have decreased from an average of 17.86 in 1977 to 8.67 in 1981.[1] One explanation for this decline is that absenteeism is generally highest on the most strenuous runs of very long duration, (i.e., high spread time); these long runs have increasingly been broken up and assigned as trippers to part-time drivers. The result is that full-time drivers receive more tolerable work shifts and absenteeism is reduced.[2]

The driving skills and safety records of part-time drivers are generally better than those of full-time bus operators. Full-time operators average 1.03 preventable accidents per 1,000 hours of operation, while part-time operators average only .52 preventable accidents per 1,000 hours (a preventable accident generally involved a bus making contact with a stationary object). This differential is even more significant because part-time operators drive only during peak hours, when the potential for accidents in considerably higher. Again, the long probationary period is probably a factor in the lower accident rate, perhaps making part-time drivers more cautious.

Finally, there is no meaningful difference in complaints per operator hour between part-time drivers (.00189) and full-time drivers (.00191). In short, these favorable comparisons indicate that on the basis or Seattle Metro's experience, part-time drivers' performance is as good or better than that of full-time drivers. Other districts using part-time drivers have generally found that they have lower absenteeism than regular (full-time) drivers, present no difficult training problems, and have lower accident rates.[3]

B. Cost Savings Attributable to the Program

1. Part-Time Drivers: The Basis For Cost Reduction and Projected Cost Savings

The use of part-time drivers is intended to reduce the cost of providing transit service in three ways. First, part-time drivers can be used to expand peak-hour service at minimum cost, because part-time tripper operators are not subject to the restrictive (and costly) work rules which govern the work assignments of full-time drivers. Further cost savings are

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[1]Richard Leyshon, conversation with Dan Graczyk, Manager of Base Operations, Seattle Metro, April 17, 1981.
[2]Part-time Labor, Work Rules, and Transit Costs, Kenneth M. Chomitz and Charles A. Lave, UMTA Office of Policy and Program Development, January 1981, p. D-2.
[3]Lave and Chomitz, Ibid, p. D-1.

possible because part-time drivers generally are not paid as much as regular drivers. Another possible cost reduction derives from the fact that part-time drivers usually receive fewer fringe benefits than full-time drivers.

a. Part-Time Drivers

Demand for transit service is highest during the morning and evening rush hours. The high cost of providing transit service arises mainly from the peaked nature of transit demand. At most transit districts, roughly 2/3 of the total service is provided during peak hours (usually between 6:30 and 9:00 a.m. and between 3:30 and 7:00 p.m.), and the concentration of service in peak hours has increased substantially since 1960.[1] However, peak services are the most expensive to provide, because drivers must be hired for the morning and evening rush hours even though there is little for them to do in midday. If a full-time driver is expected to work during both peaks, the work day may be 13 hours from start to finish, even though only 4 to 6 hours of revenue vehicle operation are involved.

Drivers have demanded and received compensatory pay for these long work shifts, as well as outright limitations on the duration of workshifts, in the form of several work rules. These include:

1. Eight-hour guarantee pay: Full-time drivers working split runs (e.g. 7:00-9:00 a.m. and 4:00-6:00 p.m.), or trippers are usually guaranteed 8 hours pay regardless of actual hours worked.

2. Spread penalty pay: A bonus similar to overtime is paid to drivers working shifts longer than a stipulated spread premium time (12 1/2 hours at Seattle Metro).[2]

3. Restriction of length of the maximum spread: Work assignments longer than a certain maximum spread time (13 hours at Seattle Metro) are prohibited.

4. A guaranteed minimum percentage of straight runs to split runs, to insure a lower limit on the proportion

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[1]Average peak/base ratios for U.S. transit systems, a measure of service concentration during peak hours, have risen from 1.8 to 2.04 during the 1960-1974 period (Oram, Progress in Planning, cited in Chomitz and Lave, p.16).

[2]Spread time is the total length of a shift or work assignment from beginning to end, including breaks. Drivers working shifts of lengths exceeding the spread premium time receive this extra pay, usually time and a half for the period over the spread premium time.

of straight runs to split runs (a straight run is a combination of scheduled trips making up an operator's daily assignment, usually of a specified minimum duration without an unpaid break. A split run is an assignment split into several pieces including an unpaid break, and therefore less desirable.[1]

These work rules are an important factor in the cost of providing transit service, and an important reason for the use of part-time drivers who are not covered by these rules. As Chomitz and Lave explain in Part-Time Labor, Work Rules, and Transit Costs, "the labor cost of providing bus service depends greatly on the interaction of maximum spread time, spread penalty time, and the proportion of peak service total service (i.e., the peak/base ratio)."[2]

In general,

1. For a given schedule, a decrease in spread penalty time will increase the number of runs eligible for the spread premium and increase the premium pay per run, increasing service costs.

2. A decrease in maximum allowable spread time will limit the number of split runs, and work scheduled as a split run must be broken into two trippers, at higher cost.

3. For a given set of spread rules, increasing the peak/base ratio (i.e., the proportion of service during peak periods), will increase the number of runs which incur the spread penalty and will increase the percentage of trippers which cannot be incorporated into regular runs.

Therefore, service costs increase with the peak/base ratio, and decrease with the length of the spread penalty time and maximum spread time.[3]

Work Rules and Labor Costs

Since most transit service is operated during the morning and evening rush hours, transit schedules during rush hours are usually augmented with short pieces of work of one to three hours in duration called trippers. In the absence of part-time labor, trippers can be handled in several ways:

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[1]Chomitz and Lave, p. G-3.
[2]Lave and Chomitz, p. 41.
[3]Ibid., p. 41.

1. If short (i.e. one to two hours), trippers may be incorporated into a regular run; this is the least expensive way to assign trippers, but if the peak/base ratio is high, there will be many more trippers than runs.

2. Some trippers may be paired into a split run, although this is expensive since the operator is guaranteed eight hours of pay and will probably receive spread premium pay as well. ' Also, it may be impossible to pair trippers within the maximum spread allowed for regular drivers (12 1/2 hours). Pairing may also be limited by a contractual minimum on platform time for a regular run (7 hours, 11 minutes) at Seattle Metro, or by a maximum percentage of runs that may be two-piece.[1]

3. Trippers which cannot be paired may be bid for by a regular full-time driver desiring extra work; these will be paid time and a half but no spread premium.

4. Trippers that cannot be handled by one of the means above are usually assigned to the extraboard.[2]

While some may be paired with extraboard runs within the maximum spread limit (13 hours), many will require a full-time guaranteed eight hours pay.

Consequently, the key cost factor is providing transit service is the proportion of unpairable trippers to regular runs, since (in the absence of part-time drivers) each unpaired tripper requires a full-time driver who must be paid for eight hours. The proportion of unpairable trippers will increase with the peak/base ratio and decrease as the maximum allowable spread increases. This implies that the transit districts with high peak/base ratios and narrow maximum spreads will have the most unpairable trippers, and it is these systems which have the highest potential for cost reductions from the use of part-time labor. If part-time drivers are hired to increase peak-hour service, and if more runs can be split into unpairable trippers, allowing the part-time drivers (who are not covered by eight-hour guarantee or spread rules) to handle an increasing share of expanding peak-hour service, cost reduction will be maximized. The more unpairable trippers that can be assigned to part-time drivers, the greater the potential for savings.

Seattle Metro began planning the use of part-time drivers to increase peak-hour service at minimal cost in 1977, based on

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[1]Lave and Chomitz, p. C-4.
[2]Ibid., p. C-4.

a marketing survey completed in autumn, 1976, which indicated that the off-peak market for transit service was saturated, and that the transit system should provide more peak-hour service.[1] The problem was how to expand peak hour service at minimum cost. Charles Collins, director of transit operations for Seattle Metro, summed up the situation:

> "It became clear to us that we were not going to reach our ridership goals (56.6 million trips in 1981 as opposed to 43.7 million in 1977) by increasing our off- peak ridership...so obviously we had to go after rush- hour riders in a way that wouldn't destroy the system financially ...Rush hour is two hours in the morning and two hours in the evening and there is no way two plus two equals eight - or the number of hours a full-time driver would be guaranteed and paid."[2]

Metro decided that the least costly way of expanding peak period service would be to schedule the new rush hour services as trippers which could be assigned to part-time drivers. By using part-time drivers (who were not subject to union work rules which restricted the use of full-time drivers), Metro could provide additional peak hour service at minimum cost. An internal Metro report projected cost savings from hiring part-time drivers of $2,654,000 in 1978, $3,440,000 in 1979, and $4,583,000 in 1980. These saving would result in a surplus of $94,000 in 1978, $731,000 in 1979, and $302,000 in 1980. If the part-time driver program were not implemented, operating deficits of $2,560,000 in 1978, $2,709,000 in 1979, and $4,281,000 in 1980 were forecast.[3] These projected cost savings were the major rationale for implementation of the part-time driver program.

2. Actual Cost Savings from the Part-Time Driver Program

Cost savings associated with the part-time driver program have been considerable, amounting to about $800,000 in 1978, $2,000,000 in 1979, $3,800,000 in 1980, and $4,685,415 in 1981. These savings have not reduced expenditures for operators wages, which rose form $18,910,708 in 1978 to about $48,000,000 in 1981. Most of this increase in labor costs is related to increases in drivers' wages and substantial increases in the amount of bus service provided since 1977. The cost-of-living adjustment provisions of the 1978 contract allowed the average wage of a full-time driver to increase from about $8/hour in

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[1] Urban Consortium, p. 13.
[2] "Part Time Bus Drivers: A Money Saver?", Mass Transit, January/February 1979, p. 102.
[3] "The Need for Part-Time Drivers", Seattle Metro internal report dated April, 1977.

1978 to $10.31/hour in 1981, an increase of 29 percent. The amount of bus service has also increased substantially, from 1,803,000 bus-hours of service in 1977 to 2,429,259 bus-hours in 1981, an increase of 34 percent. At the same time, the number of operators has increased from 1,158 (full-time drivers) in 1977 to 1,903 in 1981 (1,269 full-time and 634 part-time). This service expansion has also increased training costs substantially; these went from $177,685 in 1978 to $338,774 in 1979. Because of expanding service and related labor requirements, overall operating costs have increased substantially despite savings from the part-time driver program.

Savings from the use of part-time drivers, as a percentage of drivers' wages and of total operating expenses, are shown in Table VIII-3.

These cost savings are in the range of 1.5 to 4.5 percent of total operating expenses, and 4 to 10 percent of operator wage costs. The actual savings are considerably less than the projected savings of 11.5 percent of operator wages in 1978, 13.3 percent in 1979, and 16.4 percent in 1980. However, the savings from the part-time driver program have risen considerably since 1977, mainly because of the large increase in peak hour service (Metro's peak/base ratio has gone from 2.6 in 1978 to 4.1 in 1981). Prior to the part-time driver program, most trippers at Metro were assigned to the extra-board, and were covered by full-time operators at very high cost. However, as Metro expanded peak-hour service, the ratio of trippers to runs was increased so that the added service could be assigned as trippers to part-time drivers. (As of September 1977 there were 666 runs and 290 trippers; by May 1981 there were 735 straight and split runs, and 822 trippers.) Metro has divided many of its work assignments into trippers (many of which are unpairable under existing spread rules), in order to maximize the use of part-time operators.

Cost savings from the use of part-time drivers result mainly from the fact that part-time operators are not covered by the same work rules as full-time drivers (i.e., they do not get 8-hour guarantee pay and do not qualify for spread penalty pay). Metro estimates that the annual cost of two trippers assigned to a full-time operator as a split run would be $26,279; the cost of the same two trippers assigned to two part-time operators would be $12,508. A smaller cost savings stems from the limited fringe benefits provided to part-time operators, who receive only a uniform allowance, transit pass, workers' compensation and unemployment insurance. Benefits for full-time drivers, which include paid sick leave, holidays, and vacations, as well as a pension plan and medical coverage, cost about $150 per driver per month.

A breakdown of the cost savings attributable to the

TABLE VIII-3

SAVINGS FROM USE OF PART-TIME DRIVERS

Year	Savings from Part-Time Operators	As % of Driver Wage Costs	As % of Total System Operating Expenses
1978	$ 800,000	$18,910,708 (4.2%)	$53,808,958 (1.5%)
1979	2,000,000	22,938,129 (8.7%)	64,416,769 (3.1%)
1980	3,800,000		85,416,000 (4.4%)
1981	4,685,415	48,000,000 (9.7%)	

time driver program in 1981 can be derived based on the cost of using full-time drivers to provide the same service. Dan Graczyk, Metro's Manager of Base Operations, estimates that the use of part-time drivers saves about 2.3 hours of straight time (at $10.31/hour) per run or split run per day, or roughly $23.75/day, or about $475 per month.[1] Over twelve months for 635 operators, the savings are about $4,188,615/year, mainly in reduced 8-hour guarantee pay (reduction of spread penalty payments is a minor element of cost savings; in 1978, Metro paid only $414,536 in spread time premiums, and paid $385,705 in 1979, a reduction of $28,831). Since 634 part-time drivers are the equivalent of about 276 full-time drivers, the reduction in benefit costs is 276 x $150 x 12 = $496,800. This represents about 9.5 percent of the total reduction of $4,685,415 for 1981.[2]

Part-time drivers also reduce costs because on average they are paid substantially less than full-time operators. In 1981, part-time drivers received an average of about $5.00/hour, while full-time drivers received an average of $10.31/hour. While the pay scale is the same for part-time and full-time operators, tripper (part-time) operators are not eligible for a step increase on the pay scale until they have completed 2,088 hours of work, which usually requires three years of part-time work. A regular (full-time) operator is eligible for the same step increase after 1,044 hours of work, or about six months full-time work.

C. Unresolved Problems

1. Impact on Labor Relations

a. Seniority Issue

Members of the Amalgamated Transit Union (ATU) argue that the part-time driver program has caused seniority problems within the union. This situation has resulted from an unintended outcome of the part-time driver program. Metro wanted to develop a part-time work force who would remain part-time. However, because of chronically high unemployment in the Seattle area, many part-time operators seek to become full-time operators. Of the last group of full-time operators hired, about 65 percent were former part-time drivers. The former part-time drivers were given seniority over the newly-hired full-time drivers hired "off the street". This arrangement created tension within the union. One union official feels

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[1]Trippers average 2.3 hours in duration.
[2]It should be noted that these savings are implied; they represent the additional cost of providing existing services with full-time operators.

that Metro management deliberately hired drivers who had not formerly worked for Metro in order to create dissension in the union.

To resolve this seniority problem, the ATU wants "first right of refusal" for new hires (i.e, veto power), and assurances that 100 percent of full-time drivers hired will be former part-time drivers. Metro opposes this position as too restrictive, insisting that it has the right to select personnel without regard for their previous employment status. The union would also like to see promotions from part-time to full-time status made on the basis of seniority; Metro wants these promotions to be made on the basis of merit, as an incentive to encourage better performance.

Another seniority-related issue which has not been resolved surrounds the "pick", or procedure by which operators select work assignments, usually on the basis of seniority. The union claims that Metro's insistence on allowing part-time drivers to operate only one tripper per day has disrupted this work selection process. Tripper operators with little seniority have very few shifts to choose from, and may not be able to select a tripper that fits their schedule. Rather than paying these part-time drivers for 1 1/2 hours work or laying them off, union members allege that Metro has a policy of providing trippers which fit the schedules of all part-time drivers, regardless of seniority. The result is that part-time operators with little seniority receive very desirable tripper assignments over part-time and full-time drivers with more seniority, which the union feels is unfair.

Metro has used three arguments to defend its policy of allowing each part-time driver to operate only one tripper. First, Metro management felt that combining trippers for assignment to part-time drivers was a violation of work rules, since split runs are reserved for regular (full-time) drivers. Metro also wanted to ensure driver familiarity with specific routes; shifting tripper assignments frequently, it was felt, might create confusion and adversely affect service. Finally, Metro expressed concern that it would be subject to increasing pressure to promote part-time drivers to full-time status if part-timers were allowed to work longer hours.

2. Political Obstacles To Service Reassignment

The full savings anticipated from the part-time driver program have not been realized, partly because savings were predicated on a shift of 100,000 bus-hours of service from off-peak to peak periods, as proposed by Metro in late 1978 and early 1979. Metro projected the following cuts in off-peak service (in order to expand peak service) as of January 1979:

1. Reassign 50,000 hours of week night service.

2. Reassign 25,000 hours of Saturday service.

3. Reassign 25,000 hours of Sunday service.

Shifting more service to peak hours would allow Metro to provide new peak service with part-time drivers at minimum cost. However, local opposition mobilized support from city and county politicians to fight these service cuts. Metro solicited opinions from affected groups and community leaders as to which services should be reduced. The result was some relatively minor service cuts, which did little to allow expanded peak hour service intended to make maximum use of part-time operators (week night service was reduced by 14,800 hours, Sunday service by 1,100 hours, and Saturday service by 3,500 hours).

D. Criticism of the Program

1. Labor Criticisms

The Amalgamated Transit Union had several complaints about the part-time driver program, in addition to the seniority issues mentioned earlier. Dan Linville, Recording Secretary of ATU Local 587, asserted that since the part-time drivers were hired, there have been fewer straight through runs for operators despite the expansion of service. Although he could not document this claim, he felt that most union members would agree that working conditions for full-time drivers had deteriorated considerably as the number of part-time drivers increased, mainly due to the reduced choice of work assignments.[1]

The union also argued that the part-time program would not save Metro any money in the long run, because Metro sold the part-time program by claiming that the cost savings from the use of part-time drivers would permit larger pay increases for full-time drivers. A member of the executive board of the ATU did not deny that the part-time driver program has allowed larger wage increases for full-time drivers. However, he felt that any cost savings for Metro would be temporary for two reasons. First, Metro will have to hire most (if not all) new full-time drivers from among the part-time. In addition, Metro will have to negotiate with the ATU for improved pay and benefits for part-time drivers. While he felt that part-time drivers had caused some dissension in the union over seniority and work guarantees (part-time drivers want more work, while full-time drivers want limited work hours), he acknowledged that the

[1]Conversation between R. Leyshon and Dan Linville, ATU, April 22, 1981.

ATU must seek to integrate part-time members more fully into the union. He assigned highest priority to improving the pay and benefits of part-time operators to close the gap between them and full-time drivers.

2. Other Criticisms of the Program

Other criticisms of the use of part-time workers to provide transit service have been made by Kenneth Chomitz and Charles lave in a recent study, Part-Time Labor, Work Rules, and Transit Costs. The authors argue that the cost savings achievable through the use of part-time drivers will be minimal, if not illusory, for several reasons:

1. Since high labor costs are not the primary reason for transit deficits (which the authors attribute mainly to artificially low fares and extension of transit service into low density areas to achieve various social goals), reduction of labor costs for providing expanded peak hour service will do little to reduce the overall cost of service, because peak service is inherently more costly to provide than off-peak service.

2. The authors argue that "the kinds of contract concessions necessary to win the use of part-time labor can ultimately cost more than the initial savings in operator costs."[1] In order to gain the right to use part-time labor managment will have to accept strict contractual limitations on the employment and number of part-time workers, which will substantially limit potential cost savings. More important, management will probably have to provide a pay increase (i.e., in addition to cost of living adjustments) to full-time drivers to compensate them for their loss of overtime. Through a series of cost of service simulations based on various run cuts (possible work assignments), and assuming variable proportions of part-time labor (zero to 20 percent), the authors found that even if use of part-time drivers reduced total driver pay hours substantially (by 9 to 12 percent) at the beginning of the contract, compensatory pay increases to full-time drivers of 1 to 2 percent per year would produce a net negative cost saving within 3 to 5 years. Hence they conclude that "even a small increases in the basic labor wage rate, as a concession to win the use of part-time labor, can easily swamp any potential cost savings."[2]

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[1] "Is Part-Time Labor a Cure for Transit Deficits?", Charles Lave, Traffic Quarterly, Vol. 34, No. 1, January 1980, p. 74.
[2] Lave and Chomitz, Part-Time Labor, Work Rules, and Transit Costs, p. 72.

3. Savings from part-time transit labor generally do not consider the higher driver training costs and related overhead expenditures required by such programs.

4. Because of these limitations, part-time labor contracts will result in a maximum reduction of 3 to 8 percent in transit operating costs, and a 1.5 to 4 percent reduction in total service costs.

Although many of these criticisms of the use of part-time labor appear valid, it is not clear that all of them are applicable to the Seattle case. Sources at Seattle Metro denied that Local 587 was given any compensatory wage increase (i.e., over and above cost of living adjustments) to accept part-time drivers. The actual wage increase negotiated in the 1978 contract (29 percent over the 1978-1981 period) does not seem excessive. A Metro internal report, confirmed by management, indicated that Metro did offer the union improved sick leave coverage as a concession for accepting part-time drivers. However, the cost of sick leave insurance coverage was determined by the rate of absenteeism, which has been cut in half since the start of the part-time program (mainly due to the program and new disciplinary sanctions against absentees adopted in 1978). Consequently, the cost of sick leave insurance for Metro has been reduced from $1,000,000/year in 1978 to less that $100,000/year in 1981.[1] A more plausible reason for the union's acceptance of part-time drivers was Seattle Metro's willingness to take a strike if necessary in 1978, which derived from support from the business community, detailed contingency plans to mitigate any strike's impact, and the fact that only 8 percent of work trips in Seattle are made by bus.[2] Another explanation, offerred by a union source, was that the 1978 contract was negotiated by retiring union leadership which bargained away too much

Based on Seattle's experience, negotiation of the right to use part-time labor will depend upon various local factors and the strength of the union's bargaining position, and the "compensation" required for permission to use part-time labor is likely to vary considerably.

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[1] R. Leyshon, conversation W. D. Graczyk, Manager, Base Operations, Seattle Metro, January 12, 1982.
[2] U.S. Census Journey to Work Data, 1976.

V. CONCLUSIONS

On the basis of Seattle Metro's experience, modest cost savings (on the order of 4 to 10 percent in operating costs and 2 to 5 percent in total service costs) can be achieved through the use of part-time labor. Cost savings available by employment of part-time drivers will be determined by:

1. The system's service profile (i.e., the percentage of service during peak hours, or the peak/base ratio).

2. Union work rules applicable to full-time drivers (maximum spread time and spread penalty time). As the peak/base ratio increases and maximum spread time and spread penalty time decreases, the percentage of trippers that can be paired into runs will decrease. These unpairable trippers can be assigned to part-time drivers, who are generally paid less than full-time drivers and are not subject to the same work rules as full-time drivers (notably, tripper operators are not guaranteed 8 hours pay, take longer to move up the pay scale, and receive fewer fringe benefits). Most cost savings from part-time drivers result from reduced 8-hour guarantee pay for full-time drivers; fringe benefit savings are relatively minor. Cost savings are not apparent, but a measure of what comparable service would cost <u>without</u> part-time labor.

3. The number of pieces of work that can be assigned as unpaired trippers, and the number of part-time drivers who may be used to cover them will depend on negotiations with transit unions. Seattle Metro has achieved relatively large cost reductions because it has been able to increase the proportion of trippers to runs substantially (from 666 runs, 290 trippers in 1977 to 735 runs, 822 trippers) while concurrently increasing its peak to base ratio from 2.6 to 4.1. To handle the increase in trippers, Metro now has 812 tripper operators, roughly 35 percent of total operators. This increase in unpairable trippers, as well as the right to use enough part-time drivers to cover them, is essential to maximize savings from part-time labor. Metro's increased utilization of part-time drivers has helped to increase its efficiency in providing service; the ratio of platform hours to pay hours has increased from 69 percent (1977) to 80 percent (1981).

4. Cost savings elsewhere are likely to be less than at Metro, which has been able to increase tripper work assignments substantially and hire the part-time drivers to cover them. The major factor in whether a successful part-time driver program can be implemented is the

bargaining strength of the unions concerned. To the extent that work rules dictate driver assignments and limit the use of part-time drivers, savings will be reduced.

5. Contrary to assertions by critics, part-time drivers have been very dependable, having lower accident and absenteeism rates than regular drivers. Although part-time drivers have increased training costs somewhat, there is evidence that they have reduced overall absenteeism.

6. The use of part-time drivers has increased friction between labor and management. Full-time drivers feel that part-time labor has disrupted their seniority system and reduced their share of the work created by system expansion. Many union members feel that part-time workers are responsible for a deterioration in working conditions, asserting that their choice of work assignments has been reduced. To the extent that these issues remain unresolved, they will continue to arise in contract talks and encourage unions to demand contractual protection and/or extra compensation.

7. Although it is quite possible that initial labor cost reductions attributable to part-time labor may be offset by compensatory wage concessions made to full-time workers, this is not inevitable. Management and labor must analyze the potential costs and benefits of part-time labor contracts carefully.

8. In short, the use of part-time labor has great potential for reducing operating costs at most districts, although it has not prevented service costs from rising and will do little to reduce deficits. Nevertheless, it is an option work investigating.

IX. SOUTHERN PACIFIC FARE STABILIZATION PROGRAM, San Mateo County Transit District (SamTrans), San Mateo, California

I. PROJECT DESCRIPTION

The Southern Pacific (SP) Fare Stabilization Program was developed by the San Mateo County (California) Transit District (SamTrans) to stabilize and increase ridership on the Southern Pacific's commuter rail service between San Francisco and San Jose after a 25 percent fare increase in 1977. This line, which primarily serves commuter trips between San Francisco and two suburban counties (San Mateo and Santa Clara) had been losing ridership steadily since the late 1950's. Despite several fare increases, by 1976 the operating deficit had reached $9.4 million, and the railroad was attempting to abandon the service.

The main objective of the Fare Stabilization Program, a temporary user-side subsidy, was to promote use of SP rail service and prevent further patronage losses by selling commuter tickets to County residents at a 30 percent discount, thus offsetting the fare increase. The program was designed to stabilize and reverse the declining ridership trend in order to prove that utilization of the service could be increased even without major schedule changes or facility improvements. An increasing ridership trend would also establish continuing need for the service, which was essential to prevent abandonment and gain support for the large public expenditures needed to improve service quality.

After the passage of essential enabling legislation by the California Legislature in 1977, the Fare Stabilization Program began in January 1978. SamTrans arranged to sell commuter tickets through Southern Pacific ticket offices at a 30 percent discount, using State funds from the Transportation Development Act (TDA) to cover the deficit. Discounts were restricted to San Mateo County residents, and the discount applied only to commuter tickets (one-way and round-trip tickets were not discounted). Similar fare discount plans were offered by the neighboring counties of Santa Clara and San Francisco.

Over the duration of the program (January 1, 1978 to August 1, 1980), rail commuters in San Mateo County received ticket discounts worth roughly $1,578,048 (which was also the approximate cost of the program). Despite the 25 percent fare increase in 1977, passenger counts made in October 1977 and October 1978 indicate a patronage increase of 1.4 to 2.2 percent, even though a decline of 4 percent was expected on the basis of longterm ridership trends. Commuter tickets sold increased 1.7 percent and total tickets .5 percent on a yearly basis between 1977 and 1978, despite an anticipated decline of

6 to 8 percent. Program impact on ridership after March 1979 is uncertain, because of gasoline shortages and price increases. While ridership has declined 5 to 10 percent since the program ended, patronage is still 35 percent above 1977 levels. Although the program had very little impact on vehicle-miles traveled, fuel consumption, or vehicular emissions, the program's success in stabilizing ridership was an important factor in negotiation of a long-term purchase of service contract between Southern Pacific and Caltrans (in May 1980), and in encouraging State and Federal agencies to initiate a program of equipment modernization and service improvements.

II. PROJECT BACKGROUND

A. Service Environment

Southern Pacific (SP) and its predecessor companies have operated passenger rail service on the San Francisco Peninsula since 1864. This rail line, which links the Central Business Districts of San Francisco and San Jose (California's third and fourth largest cities), extends nearly 47 miles, serving 24 intervening jurisdictions and unincorporated areas in San Mateo and Santa Clara Counties (see Map IX-1). SP's right-of-way is located in the West Bay corridor, an intensively developed area inhabited by 2.4 million people (1976 population estimate). Most transportation facilities in this region have been built in this natural corridor next to the Bay because it is flat and unobstructed by the Santa Cruz Mountains to the west. These topographic restrictions have also concentrated regional population and commercial development in the West Bay corridor.

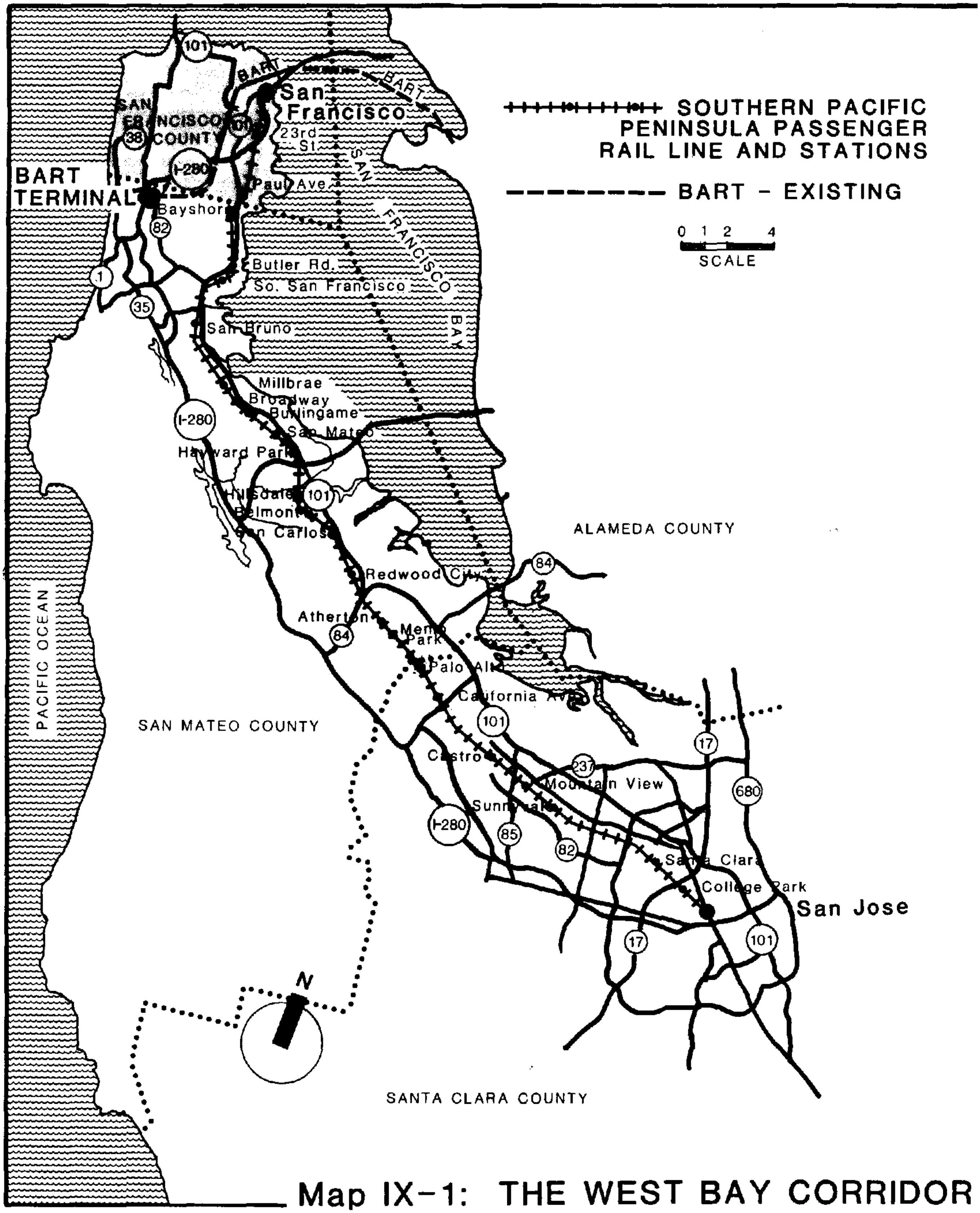
1. Commuter Rail Service Characteristics

Southern Pacific operates its Peninsula commuter service daily, with 22 trains in each direction on weekdays. The route is 46.9 miles long, and the San Francisco to San Jose run is made in about 1 hour and 20 minutes. The service schedule is heavily oriented towards serving Peninsula commuters traveling to San Francisco in the morning peak and returning in the afternoon peak. Of the total 44 weekday runs, 12 leave San Jose during the a.m. peak between 6:00 and 9:00 a.m., and 12 leave San Francisco between 4:00 and 7:00 p.m. Service frequency is reduced to 12 trains in each direction on Saturdays and 9 on Sundays. Service in the late evenings and in off-peak directions is sparse. (Just recently this schedule was revised with the addition of two more reverse peak runs to San Jose in the morning and from San Jose in the evening, bringing the daily total of trains up to 46).

Compared with other commuter rail operations in the U.S., fares are low and the service is dependable. Costs of providing service compare favorably with other commuter rail lines, although labor costs are relatively high.

2. System Ridership Characteristics

The vast majority of SP riders are commuters (85 percent), and 90 percent are bound for employment locations in the San Francisco CBD. Even among off-peak riders, 70 percent are traveling to or from San Francisco. Most riders (80 percent) use the service five days per week, and the majority are from middle and upper middle income groups and hold white collar jobs. A high percentage of these commuters own cars; few are transit dependent, and autos are the preferred mode of access



Map IX-1: THE WEST BAY CORRIDOR

(used by 50 percent) to SP stations, which, because of corridor development patterns, are usually within 3 to 5 miles of riders' residences. Among the reasons cited for using the commute service in a 1980 Caltrans survey, the most important were travel cost savings (mentioned by 63 percent), the high cost of gasoline (50 percent), dependability (46 percent), convenience (36 percent), speed (30 percent), and avoidance of downtown parking costs (25 percent).[1] In the West Bay corridor, commuter rail trips represent a small share of work trips (currently, about 18,000 of 500,000 daily trips crossing the San Mateo-San Francisco County line from San Mateo and Santa Clara Counties, or slightly less than 4 percent of the total). The rail share of work trips to San Francisco from San Mateo County is somewhat larger. The 1970 Census journey to work data indicated that approximately 7,100 of 63,000 San Mateo County residents working in San Francisco, commuted by train, (or about 11 percent).[2] Present weekday ridership on the SP commute service is approximately 9,000 passengers/day in each direction for a total of roughly 18,000 person trips. About 46 percent of these rail trips originate in San Mateo County, the balance from Santa Clara County with a small percentage from San Francisco County.[3]

B. Regional Development and Population Trends, 1940-1975

Accessibility provided by various transportation modes has encouraged and concentrated residential and commercial development in the West Bay corridor. Concentrations of employment developed first along El Camino Real (California Highway 82, similar to U.S. 1 on the eastern seaboard), and later developed in proximity to the railroad and the freeway system. An urbanized corridor developed along the rail line and the three principal roads on the Peninsula: El Camino Real, I-280, and U.S. 101 (the Bayshore Freeway). Prior to 1920, retail facilities and offices developed in relation to local main streets leading to railroad stations. More recently, office and industrial park development has occurred on vacant land adjacent to the freeway system, especially near the Bay.

The result of these development patterns is that land use east of the SP line is mainly industrial and commercial, while land use to the west is mainly residential. San Francisco and San Jose have continued to develop as major regional office and

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[1] California Department of Transportation (Caltrans), San Francisco Peninsula Rail Survey Report, July 1, 1981 (hereafter: Caltrans, 1981), pp. 31 and 126.

[2] The Feasibility of Upgrading Peninsula Passenger Rail Service (PERSUS), Metropolitan Transportation Commission, Berkeley, CA, February 1975, p. III-24.

[3] Caltrans, 1981, p. 29

service centers. Consequently, the major flow of commuters is from the western residential area to employment sites located in the central (downtown) or eastern portions of the corridor, and north-south along the corridor from Peninsula communities to San Francisco and, increasingly, in the reverse direction to San Jose.

1. Demographic Trends

During the 1940-1970 period San Mateo County, like the Bay Area in general, experienced great population growth. San Mateo County's population grew by 89 percent between 1950 and 1960, and by 25 percent from 1960 to 1970. A substantial part of this increase was related to outmigration from San Francisco, facilitated by the accessibility provided by the automobile and an expanding network of freeways. The 1960, 1970 and 1976 estimates of the populations of San Mateo County communities are presented in Table IX-1. During the 1970-1980 period, the population of San Mateo County increased only 5 percent, reflecting the extent of existing development, as well as the movement of some firms into less densely populated Santa Clara County and into San Francisco.

2. The Decline of Transit Ridership, 1940-1977

Mass transit usage in the West Bay corridor, and SP patronage in particular, have declined substantially since World War II. Major highway construction in the corridor, along with rising income and access to autos has dispersed commercial and residential development further from downtown areas in the SP corridor.[1] Although development has remained more concentrated than in some other areas of California because of topographic constraints, the low-density development characteristic of the postwar era has made conventional transit service less attractive.

The result of this postwar development trend has been a cycle of service reductions and fare increases by transit operators.[2] Southern Pacific ridership peaked during the 1942-1955 period, averaging about 8.5 to 9.5 million riders per year. In 1956, ridership began to decline, and decreased 30 percent between 1965 and 1975, reaching a low point of 4.3 million in 1977, or about 7,000 daily passengers in each direction

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[1]The economy of San Mateo County is based on employment in services (61 percent of the total), including engineering, high technology, and government. Median household income ($17,315 in 1975) is among the highest in the state).

[2]Ridership on Greyhound's San Francisco-San Jose service (both local and express) declined by 57 percent between 1965 and 1975.

TABLE IX-1

POPULATION AND AREA CHARACTERISTICS
WEST BAY CORRIDOR COMMUNITIES

AREA		POPULATION		
		1976[5]	1970[1]	1960[6]
DALY CITY	4,400[3]	73,100	66,922	44,791
COLMA	1,600[3]	510	537	-- [7]
BRISBANE	1,400[3]	3,010	3,003	-- [7]
SOUTH SAN FRANCISCO	6,100[3]	49,250	46,646	39,418
SAN BRUNO	3,560[2]	39,900	36,254	29,063
MILLBRAE	2,062[2]	20,250	20,781	15,873
BURLINGAME	2,900[3]	27,450	27,320	24,036
HILLSBOROUGH	4,000[3]	9,500	8,753	7,554
FOSTER CITY	2,400[3]	20,850	8,389	-- [7]
SAN MATEO	7,139[2]	79,000	78,991	69,870
BELMONT	2,900[3]	25,550	7,671	15,996
SAN CARLOS	2,900[3]	26,800	25,924	21,370
REDWOOD CITY	21,644[3]	54,700	55,686	46,290
ATHERTON	3,200[3]	7,775	8,085	7,717
WOODSIDE	8,100[3]	5,275	4,731	3,592
MENLO PARK	7,700[3]	26,300	26,734	26,957
PALO ALTO	16,448[4]	54,900	52,623	52,287
PORTOLA VALLEY	5,800[3]	4,980	4,999	-- [7]
LOS ALTOS	4,230[4]	26,250	26,260	19,696
LOS ALTOS HILLS	6,400[4]	7,225	6,993	3,412
MOUNTAIN VIEW	9,825[2]	55,800	54,132	30,889
CUPERTINO	4,540[4]	22,900	22,023	3,664
SUNNYVALE	14,720[4]	105,000	102,154	52,898
SANTA CLARA	11,470[2]	83,800	82,118	58,880

[1] 1970 Census of Population, U.S. Dept. of Commerce.
[2] Source: Respective City General Plan.
[3] Source: Approximate only, based on San Mateo County Planning Department Tabulations
[4] Source: Respective Planning Department Staff Response (some are approximations).
[5] Population Estimates of California Cities and Counties, Report 77 E-1, Population Research Unit, California State Department of Finance.
[6] 1960 Census of Population, U.S. Dept. of Commerce.
[7] Urban places with less than 2,500 population were not reported.

TABLE IX-2

Southern Pacific Transportation Company
Ridership (Based on Total Rides Sold) San Francisco-San Jose, 1970-1981

Month	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Jan	511,492	480,075	458,635	473,486	495,266	447,204	395,750	363,544	386,356	403,074	541,703	498,605
Feb	460,832	454,289	438,993	412,067	456,510	380,198	349,773	331,054	333,559	348,883	500,648	450,985
Mar	517,262	526,006	516,005	462,809	536,902	407,587	407,525	394,338	388,750	400,195	531,418	523,268
Apr	503,254	489,533	421,130	442,182	496,804	416,534	345,841	352,375	344,392	430,082	536,858	514,464
May	486,492	445,681	502,469	462,138	492,746	401,960	345,190	369,869	383,148	562,058	526,448	478,722
Jun	507,187	445,553	498,103	424,561	416,884	373,220	355,961	357,862	351,601	489,530	504,846	
Jul	469,481	395,444	418,836	438,315	461,775	391,576	356,949	353,214	342,889	517,960	550,445	
Aug	454,888	388,504	437,629	448,490	424,614	352,766	356,101	382,831	366,342	522,446	445,774	
Sep	476,326	417,053	419,982	415,981	432,330	396,386	352,515	349,558	336,367	475,716	484,225	
Oct	471,515	454,003	474,216	490,852	459,822	410,375	361,985	356,297	386,332	558,716	522,870	
Nov	479,493	487,044	431,227	472,827	437,070	367,901	379,861	367,011	378,230	521,976	485,118	
Dec	487,331	500,677	421,778	441,876	412,702	373,972	358,313	341,998	343,045	468,565	482,537	
Year	5,825,552	5,483,762	5,439,053	5,385,584	5,523,185	4,719,679	4,365,764	4,319,973	4,341,011	5,699,406	6,112,890	
Change		-6%	-1%	-1%	+3%	-15%	-7.5%	-1%	+.5%	+31.3%	+7.25%	

Fare Increases - 10/07/70 - 5% General Fare Increase
12/18/71 - 10% General Fare Increase
10/25/73 - 6% Offset Increase to recoup from railroad retirement tax change.
12/22/73 - 11% General Fare Increase
9/18/74 - 8% Offset Increase on account of rise in cost of fuel
8/06/77 - 25% General Fare Increase (Filed in August, 1974)

SOURCE: San Mateo County Transit District (see Table IX-2 for 1970-1980 annual ridership statistics). SP's service provided declined from 64 trains per day in 1940 to 44 in 1960, and the railroad was granted frequent fare increases between 1967 and 1977 (see Table IX-2). With shrinking service and increasing fares, SP ridership declined constantly since 1970, except for a small increase (about 1 to 3 percent) during the 1973-1974 gasoline crisis. Consequently, SP's commuter service, provided by the railroad without public subsidy as a public utility obligation, operated at a deficit which reached $9.4 million in 1976.

Although changing demographic and travel patterns account for most of the decline in SP ridership, losses occurred for other reasons as well.[1] These included:

1. Highway construction, which encouraged dispersed suburban development, also improved auto access to the San Francisco downtown area. Off-street parking availability in San Francisco increased 23 percent between 1965 and 1975, largely as an unintended result of urban renewal.[2]

2. SP's terminal location in San Francisco was inconvenient for travel to CBD destinations.

3. SP did nothing to encourage use of the service.

Meanwhile, highway congestion at peak hours has worsened.[3] Highway traffic is severely impeded by congestion at several points on area freeways, including portions of U.S. 101 in the vicinity of San Francisco International Airport; U.S. 101 and I-280 between their point of convergence and downtown San Francisco; and the segment of I-280 immediately before it merges with U.S. 101. Delays on U.S. 101 are also common in the southern portion of the corridor in the vicinities of San Mateo, Redwood City, Palo Alto, and the junction with State Route 85. Interstate 280 is congested during peak hours at its southern end in and near San Jose, as well as near San Francisco.

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[1] "Recent trends of population dispersion away from central city areas served by SP and the movement of industry from San Francisco into the Peninsula have doubtless contributed to the decline in SP ridership." ICC Final Environmental Impact Statement, October, 1978 (hereafter: ICC FEIS), pp. 3-13.

[2] Parking Management Plan, City of San Francisco, December 1975.

[3] See Table IX-3 for average daily traffic (ADTs) at key intersections.

TABLE IX-3

AVERAGE DAILY TRAFFIC COUNTS

YEAR	BAYSHORE FREEWAY (#101)						#280 FREEWAY			
	BROADWAY-BURLINGAME PASSING COUNT		SAN BRUNO-SAN BRUNO INTERCHANGE		SAN FRANCISCO-ARMY STREET INTERCHANGE		MILLBRAE-LARKSPUR DRIVE INTERCHANGE		SAN FRANCISCO ARMY STREET INTERCHANGE	
	ANNUAL ADT	PEAK HOUR	ANNUAL ADT	PEAK HOUR	ANNUAL ADT	PEAK HOUR	ANNUAL ADT	PEAK HOUR	ANNUAL ADT	PEAK HOUR
1953	109,000	9,600	97,000	6,700	174,000	15,700	8,900	1,050	-	-
1964	108,000	10,300	99,000	9,400	164,000	14,800	9,400	1,600	-	-
1965	107,000	10,100	98,000	9,300	164,000	14,700	11,900	1,750	-	-
1966	118,000	10,600	107,000	9,600	168,000	15,200	12,200	1,800	-	-
1967	119,000	11,300	106,000	10,100	177,000	16,800	14,300	2,150	-	-
1968	131,000	12,400	116,000	11,000	183,000	17,400	18,300	2,750	-	-
1969	140,000	13,300	121,000	11,500	200,000	14,500	23,000	3,450	-	-
1970	135,000	12,800	114,000	10,500	187,000	17,800	41,500	6,200	-	-
1971	133,000	12,600	119,000	11,300	191,000	15,000	41,500	5,000	-	-
1972	136,000	12,900	124,000	11,800	189,000	18,000	50,000	5,500	-	-
1973	137,000	13,000	125,000	11,900	190,000	18,100	58,000	6,400	-	-
1974	137,000	13,000	125,000	11,900	190,000	18,100	58,000	6,400	41,500	3,750
1975	137,000	14,000	125,000	11,900	188,000	17,900	69,000	7,600	56,000	5,100
1976	145,000	13,700	133,000	12,600	199,000	15,900	73,000	8,000	59,000	5,300
1977	**152,000**	**14,400**	**140,000**	**13,300**	**209,000**	**16,700**	**76,000**	**8,400**	**62,000**	**5,600**

SOURCE: DIVISION OF HIGHWAYS, DEPARTMENT OF TRANSPORTATION, STATE OF CALIFORNIA - ANNUAL TRAFFIC CENSUS.

COUNTS ARE MADE WITH AUTOMATIC TRAFFIC INDICATORS AND COUNTS SHOWN REPRESENT ANNUAL AVERAGE DAILY TRAFFIC; ALSO PEAK HOUR TRAFFIC.

Volumes shown are two-way.

Regional transportation plans do not call for any expansion of highway facilities in the corridor in the near future, as any new highway construction would be disruptive of communities and the environment. These mobility problems were of increasing concern to area planners, employers, and political leaders during the 1960's and 1970's.

C. Regional Transportation and Environmental Planning (1960-1975)

The future of the Southern Pacific Peninsula commuter service has been a major consideration in regional transportation planning since the early 1960's. More recently, regional planning efforts have considered the SP passenger service to be a crucial element not only of the region's transit system, but also vital to the attainment of regional land use and environmental goals. Extensive transportation and environmental planning studies conducted during the 1960-1977 period examined transit alternatives for the region, and ultimately recommended upgrading of existing transit services, including the Southern Pacific. These plans eventually led public agencies to take a number of actions, such as the Fare Stabilization Program, to implement the chosen alternatives.

1. Regional Transit Planning: The Southern Pacific and the Bay Area Rapid Transit (BART) District

During the 1960-1975 period, the major transit planning issue for San Mateo County was the feasibility (and desirability) of extending the BART rapid rail transit system further south into the County, beyond the planned terminus at Daly City.

In late 1961, after a public hearing on BART, the San Mateo County Board of Supervisors voted unanimously to withdraw from the San Francisco Bay Area Rapid Transit District, citing the high property taxes which BART would require and the existence of the Southern Pacific passenger service.

However, many political and business leaders felt that BART extension would benefit the entire Bay Area, and efforts to extend the system continued. As the original BART system (which terminated at Daly City) neared completion in 1969, the City of San Francisco, which favored BART extension to the airport, invited San Mateo County and the BART District to participate in a study to investigate problems involved in extending transit service to northern San Mateo County and the Airport.[1] The resultant San Francisco Airport Access Project (SFAAP)

[1] PBTB - Wilbur Smith - Kirker Chapman, San Francisco Airport Access Project, May 1972, p. 1 of summary.

indicated that BART extension to the Airport would cost $400 million. The study participants realized that San Mateo County would probably reject the higher taxes needed to build an extension, which would include only eight miles of the County. To gain additional financial and political support, the SFAAP proposed an extension of BART through San Mateo to Menlo Park for an additional $300 million. (This estimate had already risen to $500 million by 1974.)[1]

After the SFAAP recommended extending BART down the Peninsula, in 1972, San Mateo County and the Metropolitan Transportation Commission (MTC), the Metropolitan Planning Organization (MPO) for the region, collaborated in the San Mateo County Transit Development Project (SMCTDP) to conduct "preliminary planning of a rapid transit extension from contemplated BART facilities at San Francisco International Airport south to the vicinity of Menlo Park."[2] The project's sponsors hoped that the study would create interest in a November 1973 referendum on BART extension. An observer of these proceedings argues convincingly that the staff and the governing Board of Control (composed of representatives of the three Peninsula counties from the MTC and County Boards of Supervisors) were clearly sympathetic to extension of BART.[3]

Because of the pro-BART orientation of the SMCTDP Board of Control and project staff, the study ignored alternatives to BART extension, including the possibility of upgrading the Southern Pacific service. The Project Director urged the Board of Control to exclude the option of upgrading the Southern Pacific, which he criticized as "...not a meaningful alternative. It is not necessary to pay for an engineering study to conclude that improvements of this character would entail fully replacing the existing Southern Pacific capital plant."[4] He also deleted a chapter titled "Upgrading Southern Pacific" from the Identification of Alternatives report. Subsequently, the Board of Control refused to consider a proposal to study improvement of the Southern Pacific as an alternative to BART made by West Bay Railway, a corporation which was interested in making substantial improvements in SP's service. After the Southern Pacific rejected West Bay's detailed suggestions for improvements, West Bay's general manager Scott McGilvray tried to convince the SMCTDP Board that upgrading the railroad could be a viable (and preferable) alternative to BART extension. However, both the project Board and staff turned down the idea

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[1] Lewin, p. 28.
[2] San Mateo County Transit Development Project, April 13, 1972 p. 1.
[3] Ibid., p. 31.
[4] Memorandum to SMCTDP Board of Control from Sidney Cantwell, Project Director, October 13, 1972 (from Lewin).

of upgrading Southern Pacific's commuter service, the existence of which, ironically, was the major reason given for San Mateo County's withdrawal from BART in 1962.[1] The Board felt that its major purpose was to study BART extension, but when it proposed to study only a BART feeder bus system, the Urban Mass Transportation Administration insisted that a county-wide bus system also had to be studied for the project to receive Federal funds.

Efforts to include citizen input in the SMCTDP were largely unsuccessful; the neighborhood impact and development implications of BART, which worried many people, were barely considered or addressed at public meetings. The study was criticized by a number of civic leaders as an attempt to justify BART without considering other alternatives.[2] Although the SMCTDP continued to ignore alternatives to BART, the study's results and the lack of effective citizen involvement greatly reduced the chances of extending rail rapid transit down the Peninsula. The study indicated that construction of BART would require demolition of low-income housing, and that it would significantly increase land values adjacent to the right-of-way, generating pressure for more intense development.[3] If BART were extended into San Mateo County, the study proposed to allow SP to abandon all Peninsula passenger service (as requested by the railroad) to the detriment of Santa Clara County. The BART extension could not have been operational before 1984,[4] and after the fuel crisis of 1973-74 many felt that public transportation improvements were needed immediately. BART extension was also criticized by minority groups, whose neighborhoods would be most heavily impacted by construction, and who felt that the system was designed for suburban commuters and did not meet their needs for local transit.

Because of the high anticipated costs, potential for neighborhood disruption and development impacts, as well as the long period needed for construction, by 1974 there was considerable opposition to the extension of BART in San Mateo County from both community groups and government agencies.[5] This opposition, which was evident at public hearings held in San Mateo County, motivated local political leaders to consider upgrading Southern Pacific service as an alternative to BART extension. Proponents of this option felt that an upgraded commuter railroad could provide service comparable to BART at much lower cost and much sooner, with minimal community disruption and

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[1] Lewin, p. 62.
[2] _Ibid._, pp. 31-32.
[3] _Bayside Transit Impact Analysis_, Marc Cohen, San Mateo County Planning Department, 1972, pp. 7-8.
[4] Lewin, _Ibid._, p.41.
[5] _Ibid_, p.34.

development impacts. A report summarizing the advantages of upgrading the SP rail service, concluded that "the proposed alternative to BART is one which will cost less money, efficiently utilize existing systems and resources, reduce the total demand for transportation, limit development pressure, and be multi-modal and implementable incrementally within a relatively short time period."[1] Consequently, several city councils and the San Mateo County City Managers Association passed resolutions urging the SMCTDP to consider the SP alternative. The Project responded by asking the San Mateo County Board of Supervisors to request that the MTC authorize a study of the possibility of upgrading the SP.

2. Upgrading the Southern Pacific: The PERSUS Report

In 1974, the MTC responded to a resolution passed by the San Mateo County Board of Supervisors urging investigation of the SP alternative by funding a $75,000 study to examine the feasibility of upgrading SP's passenger service.[2] The result was an MTC study completed in 1975 entitled The Feasibility of Upgrading Peninsula Passenger Rail Service, also known as the PERSUS (Peninsula Rail Service Upgrading Study) report. The report investigated the "political and legal implications of integrating the existing Southern Pacific Commuter Service..., into the Bay Area Regional Transportation System" and the "feasibility of upgrading levels of service through public assistance."[3] Although the report carefully examined the administrative, financial and technical problems involved in several possible options for improving SP service as an alternative to BART, and assessed the potential market for upgraded service, it did not make a direct comparison of costs and benefits of SP improvements with BART extension. The PERSUS report examined three upgrade options in detail:

1. Minor upgrading of the commuter service, retaining SP ownership and financing, and using existing station facilities with improved access.

2. Major upgrading of the service, including relocation of the San Francisco terminal to a more central location, or link to BART in Daly City, as well as increased train service improvements of facilities and equipment modernization, with the aid of public subsidies.

3. Conversion of the line from commuter to transit

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[1] Ibid., p. 60.
[2] Ibid., p. 34.
[3] The Feasibility of Upgrading Peninsula Passenger Rail Service (PERSUS), Metropolitan Transportation Commission, Berkeley, CA, February 1975, p. 6.

> service, involving construction of additional track to separate rail passenger and freight, elimination of grade crossings to allow frequent service during most of the day, and initiation of service to the airport.[1]

While the report did not specifically recommend any of the three options, it did make some conclusions which indicated that the SP service could be improved with public agency participation.

Overall, the PERSUS report was positive about the future utility of an upgraded SP service, concluding that with "a relatively modest modernization program accompanied by development of a better located downtown terminal, the future potential of this (SP) operation as an important longer-haul Bay area commuter/suburban user link appears to be excellent. It possesses the principal attributes required to meet the growth of public transportation demands as dictated by the economy and its accompanying fuel conservation needs."[2]

The PERSUS report concluded that upgrading the Southern Pacific was both desirable and possible, at least in theory. The report was much less optimistic about the actual feasibility of implementing any of the upgrade options because of the persistent unwillingness of Southern Pacific management to accept public subsidies or make improvements in an unprofitable service. SP's position on commuter service improvements was summarized by the PERSUS report as stated below:

- o SP would continue to operate passenger service between San Francisco and San Jose only if it could be done without incurring a loss.
- o SP would invest additional capital in the peninsula passenger service only if it resulted in placing the operation on a non-loss basis.
- o SP would not accept a direct subsidy for the peninsula passenger service since such acceptance usually involves loss of control of the railroad's own operation.
- o SP would protect the interests of its peninsula freight customers; it could not provide appreciably improved passenger service over present facilities without jeopardizing those interests.[4]

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[1] PERSUS Summary Report, MTC, 1975, p. 26.
[2] PERSUS Summary Report, MTC, 1975, p. 44.
[3] PERSUS Summary Report, MTC 1975, p. 44.
[4] PERSUS Summary Report, MTC, 1975, p. 44.

Legal opinion consulted during the study indicated that SP had a legal obligation to provide service and that the California Public Utilities Commission (CPUC) had the authority to compel SP to improve the service.

However, although the CPUC had refused to allow SP to abandon the service, no substantive improvements in service had been ordered or made. Moreover, the PERSUS report asserted that since commuter service improvements would be costly and probably require equipment modernization and new facilities (such as centralized traffic control to minimize interference with freight service), any upgrading would be contingent upon the approval of SP management and the availability of public sector subsidies. "Any real expansion of (SP) service coverage and performance...would require a combined degree of facility and equipment upgrading that would necessitate both management acceptance and the furnishing of considerable financial assistance by the public sector."[1]

The PERSUS report and subsequent transit studies generally assumed that the Southern Pacific, which had the expertise and trained personnel needed to provide commuter services, would continue to operate these services. Public agencies would provide funds for service improvements and specify service standards, but would not be involved in day-to-day operations. Railroad cooperation in making service improvements would be essential.

Consequently, the PERSUS report argued that under existing conditions (SP operation of the service and ownership of the facilities) service improvements could only come about through some kind of public-private cooperative agreement, to be negotiated with the SP.

The report suggested that the best mechanism for improving service and modernizing equipment would be a purchase of service agreement between the public authority and the railroad.

A purchase of service agreement would have several advantages. It would assure continuation of railroad service and give the designated public agency considerable authority to plan and implement service improvements. The public agency would also act as a conduit for state and Federal capital grants and/or operating subsidies, which could not be given to the Southern Pacific, a private company. Day-to-day operation and maintenance of the railroad would be done by SP's current employees who had the necessary operating experience, rather than by the public authority. A purchase of service agreement, as recommended by the PERSUS report, would combine the most desirable aspects of public and private management.

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[1]PERSUS Report, p. I-2.

Unfortunately, a contract of this nature was not feasible in 1975, because of the continued uncertainty of local government agencies over corridor transit alternatives. More importantly, SP management remained unwilling to consider options for preserving or improving the service, and instead continued to petition the PUC for fare increases while searching for an arrangement that would allow abandonment of Peninsula commuter operations.

Although the PERSUS report answered many questions about the feasibility of improving SP service, it did not resolve the fundamental issue of whether BART should be extended down the Peninsula. Consequently, the California Legislature passed a bill (SB 283) in 1975 directing the MTC to "conduct a study on alternate forms of transit within the West Bay Corridor in the San Francisco Bay area." The study was to determine (and compare) the feasibility of upgrading SP's commuter service to a transit service level, extending BART from Daly City to San Jose, building BART to the San Francisco Airport, and upgrading the SP from Millbrae to San Jose, or implementing other transit options. A cost comparison of the transit alternatives considered, as well as recommendations, were to be included in the MTC report, due in January 1977.

3. <u>The Peninsula Transit Alternatives Project (PENTAP report)</u>

PENTAP's main objective was to examine alternatives for a future transit system and to recommend the preferred alternative to the MTC for incorporation into the Regional Transportation Plan for eventual implementation. Reduction of dependence on the automobile and development of improved public transit were key objectives of both regional and local transportation plans. The report considered many service options, including extension of BART to San Jose, development of a comprehensive regional bus system, and various intermediate combinations of BART, local bus, express bus, and commuter rail service. PENTAP considered a wide range of corridor transit alternatives, using many criteria to evaluate the options, including:

1. Impact on urban and regional development patterns.

2. Impact on transportation operations--ridership, modal usage, capacity, flexibility, travel patterns, transit operations (quality and quantity), service frequency, travel time, etc.

3. Impact on socio-economic development--mainly the effects of alternatives on transit-dependent groups (SB 283 required PENTAP to study transit options for the transit dependent in a separate report).

4. Impacts on the physical environmnt--on air quality,

noise, open space, and energy consumption.

5. Implementation prospects--including public acceptance, time required for completion, institutional compatibility, ability to be implemented incrementally, flexibility and overall feasibility.

6. Financial requirements--Capital and operating costs (per passenger), and availability of funding.[1]

Using these criteria, the project analyzed 25 alternative systems incorporating varying proportions of bus, commuter rail, and BART service.

The PENTAP Project Committee agreed to adopt the alternative which advocated integration and unification of Southern Pacific rail and Greyhound bus operations under a single public management; supplementing these with county bus operations, and expanding these as needed in order to provide a coordinated corridor transit service, along with improved local bus service for the transit dependent and for rail station access.[2] The selected alternative, known as Alternative B, included the following specific recommendations:

1. The Southern Pacific service should be upgraded as the major element of corridor transportation by improvement in scheduled peak reverse commute service (southbound A.M. and northbound P.M.), improved service to Peninsula stations, and modest improvements in off-peak schedules, stations, and parking facilities. All improved service should be operated by the Southern Pacific under a purchase-of-service agreement.

2. The present Fourth and Townsend terminal location in San Francisco should be retained, but improved collector/distributor bus service there should be provided, linking the terminal to major destinations in the San Francisco CBD.

3. Supplemental express bus service should be provided on I-280 and US-101, linking Peninsula communities with San Francisco, San Francisco Airport, and San Jose.

4. Improved facilities for bus movement should be provided on US-101 between I-380 and I-280, either through construction of new bus lanes within the existing right

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[1]Metropolitan Transportation Commission (MTC), Peninsula Transit Alternatives, Summary Report, January 1977, Berkeley, California (hereafter: PENTAP, Summary Report), pp. 2-5.
[2]PENTAP, Summary Report, p. 1-3.

of way or reserved use of existing lanes.

5. Improved coordination of corridor service with local transit systems in Santa Clara and San Mateo Counties, to ensure adequate rail station feeder service and provide for the needs of the transit dependent population.[1]

The PENTAP report recommendations, which emphasized the preservation and improvement of existing bus and rail services rather than development of capital-intensive new systems like BART, were consistent with the views of most transportation officials and government agencies in the West Bay corridor. Accordingly, the Metropolitan Transportation Commission (MTC) accepted the PENTAP report's recommendations, and voted to incorporate Alternative B into the Regional Transportation Plan in April 1977. Upgrading the Southern Pacific service was made regional transportation policy, and planning for implementation of this option began.

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[1] PENTAP, Final Report, pp. 153-154.

III. PROGRAM PLANNING AND IMPLEMENTATION

A. Institutional Arrangements

1. Development of SamTrans (San Mateo County Transit District)

After a resolution by the County Board of Supervisors and a favorable vote of the majority of County electors, SamTrans was created in January 1975 in order to develop a coordinated transit system providing service to 550,000 San Mateo County residents. The District began full operations in 1976, and consolidated twelve public transit systems previously operating in the County. SamTrans serves virtually all municipalities in San Mateo County, and in 1977 operated about 170 buses over 67 routes, carrying about 42,000 passengers/day. In July 1977, Sam Trans entered into a purchase-of-service contract with Greyhound Lines to provide mainline, north-south service in San Mateo County.[1] This arrangement is still functioning.

SamTrans participated in MTC's PENTAP study, and consistent with the recommendation of that report, on November 10, 1976, the SamTrans Board formally approved Alternative B of the PENTAP study which called for extensive improvements to the existing rail-bus system.

Even before completion of the PENTAP report and the adoption of Alternative B, SamTrans and other local transit agencies, while urging the MTC to include Alternative B in the Regional Transportation Plan, sought to initiate discussions with the Southern Pacific about a purchase-of-service contract. SamTrans took the lead in attempting to negotiate with the railroad mainly because John T. Mauro, the General Manager of SamTrans, had previously been General Manager of the Port Authority of Allegheny County (Pittsburgh, PA), where he had played an important role in negotiating a three year purchase of service agreement which preserved the rail service of the Baltimore and Ohio Railroad between Pittsburgh and one of its major satellite cities. On March 10, 1976, Mauro met with SP Vice President Alan DeMoss in order to discuss a purchase-of-service agreement similar to the one negotiated in Pittsburgh. Mauro left a copy of the Pittsburgh agreement with DeMoss, who promised to discuss it further with members of the SamTrans Board and staff. However, the railroad never responded to this proposal; later, SamTrans learned that SP was unalterably opposed to any kind of public subsidy.

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[1] In 1976, the California Public Utilities Commission (CPUC) allowed Greyhound to abandon its San Francisco-San Jose bus routes; the purchase of service agreement prevented interruption and cessation of the service.

2. Southern Pacific Stance Against Subsidies

Southern Pacific's refusal to accept subsidies from a public agency was the major obstacle to negotiation of a purchase-of-service agreement, which would require the railroad's co-operation and assistance. Even though subsidies would have reduced SP's losses in operating commuter service, the railroad was opposed to subsidies for several reasons:

1. SP argued that acceptance of a subsidy would result in in a loss of control over freight operations, which would make it more difficult for SP to compete against other freight carriers (especially trucks and water carriers), which did not have these public service obligations. Consequently, the railroad felt that a subsidized "money-losing commuter operation on the Peninsula should be owned and operated by a publicly financed transit authority."[1] Only then, SP asserted, could the public obtain full benefit from tax-supported transit without restricting private carrier operations. Citing the PERSUS report's findings that the compatibility of rail passenger and freight service was limited, SP warned that increased passenger operations would adversely affect rail freight service on the Peninsula, which in turn would either cause firms to relocate elsewhere or ship by truck instead. Public subsidization of increased rail passenger operations would reduce the quality of freight service, with unfavorable impacts on the regional economy.

2. Southern Pacific claimed that its own experience and that of other railroads indicated that "a government subsidy never covers the full cost of operations. Therefore, the railroad can only look forward to perpetual losses."[2] Furthermore, SP felt that publicly owned transit operations would always have first rights to available public funds. SP concluded that it would get only leftovers, because "it is not unreasonable to assume that subsidy payments to the privately owned railroad would take the lowest priority when the always limited distribution of transit tax monies are made."[3]

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[1]Letter, A.D. DeMoss (SP) to Robert W. Naylor, Chairman, Sam Trans Citizens Advisory Committee, September 23, 1976, p. 2.
[2]Testimony of A.D. DeMoss, Vice President, Southern Pacific Transportation Co., before the California State Assembly Transportation Committee, December 2, 1977, p. 3.
[3]Ibid., p. 4.

3. SP felt that public transit subsidized with tax dollars should be as cost-effective and energy efficient as possible, and hence should be based on buses and van pools, which were superior to trains in those respects. Asserting that buses usually use less than one-half the fuel per passenger mile than trains and operate at less than one-half the cost per passenger of trains, SP stated its preference for a Peninusla transit system based on those modes: "If transit must be subsidized to meet political or social goals, then taxpayers are entitled to have those funds invested in a form of transit which provides the optimum (service per) passenger mile, thus saving energy and conserving taxpayers' dollars. The forms of transit which best meet these criteria are highway buses and vanpools... we conclude that from the viewpoint of a taxpayer and those who believe in conserving energy, funds should be dedicated to expanding the county transit bus operations and vanpools and not used for fixed rail operations which are less efficient for moving passengers."[1]

4. SP also was not inclined to accept public subsidies or enter into a purchase of service contract because it felt that such arrangements could be changed or abrogated altogether by public agencies subject to political pressure, to the detriment of the railroad. De Moss observed that: "Any agreement or understanding that Southern Pacific might arrive at with a transit district or other public authority can be changed by legislation at some future date. Even if it were possible to arrive at terms and conditions satisfactory to Southern Pacific, the history of subsidies to commuter operations shows clearly that as times change and political pressures build up, the covenants can be and are broken by legal action which follows."[2] SP feared that funding for a long term subsidy agreement would not be assured and could be terminated with little notice. The PENTAP report acknowledged that the funding issue had to be addressed: "Southern Pacific is very apprehensive about any contractual agreement to provide passenger service, even though such an agreement will probably result in an improved financial condition for the commuter operation. SP foresees a continuing struggle to avoid interference by the public manager in the decisions of the railroad; it is also concerned that the funding sources for such a contract would not be dependable. It is not clear that an

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[1] Ibid., pp. 4-5.
[2] Letter, Alan DeMoss to Robert Naylor, September 23, 1976.

agreement (with SP) can be reached. It is clear that agreement should be attempted."[1]

In another letter, DeMoss summarized SP's attitude toward commuter services: "We believe that commuter operations by privately owned railroads should provide sufficient revenues to cover costs. If there is a failure of revenues to cover costs, then the service should be reduced accordingly or owned and operated by a public transit authority. We do not believe subsidy payments are a solution and would find them unacceptable."[2]

3. Obstacles to Improvement of Southern Pacific Service

While SP's opposition to providing service on a subsidized basis was the largest impediment to efforts to upgrade the service, there were other obstacles:

1. While both the PERSUS and PENTAP reports had indicated that an upgrading of commuter service, involving equipment modernization and more frequent service, was feasible and desirable, such improvements would be costly (the PENTAP report estimated that capital improvements for Alternative B would cost $48.8 million in 1976; operating subsidies sufficient to cover losses would require $6.7 million in 1977-78 and $13.9 million in 1978-79).[3] The PENTAP report asserted that financing for the project would be provided "through a combination of Federal, state and local sources," but other than assuming that 80 percent of the cost of capital improvements would be paid by UMTA, the report was not specific about sources of revenue. Although indicating that Alternative B could be financed with existing sources of revenue, broadly described as sales taxes, fuel taxes, and Transit Development Act (TDA) funds, the PENTAP report admitted that "negotiations with SP will require assurance of a funding source over an extended time period."[4] PENTAP noted that consistent with MTC's financial plans, no new sources of funding for transit in the West Bay corridor were anticipated in the near future. However, it was not clear which of the existing sources could be tapped for financing the upgrading project, nor was it clear how much revenue would be available.

A related problem arose concerning determination

1PENTAP Summary Report, pp. 4-7, 4-8.
2Letter, Alan DeMoss to John Mauro, June 23, 1976.
3PENTAP report, Figure 45 and Table 56.
4PENTAP Final Report, p. 159.

of the costs of providing various levels of rail service. SamTrans was reluctant to accept SP's commuter service operating cost figures at face value, since a subsidy agreement based on reimbursement of service costs claimed by SP might not encourage cost efficient operations, and could provide an incentive for SP to exaggerate actual costs. This obstacle to negotiations was noted by PENTAP Committee Chairman John Beckett in a letter to Louise Giersch, Chairman of the MTC:

"There is an unwillingness to accept the validity of SPTC operating cost estimates, particularly in the absence of having an opportunity to seriously explore potential cost savings in concert with SPTC. As a result, it is not possible to determine the specific level of subsidy needed to sustain the existing level of SP services, nor is it possible to judge how much additional service will cost..."[1]

Another financing issue to be resolved was the extent of operating assistance to be provided by Federal, State, and local governments. MTC's Transit Financing Study submitted to the Legislature in January, 1977, adopted a fare level guideline which would require 35 percent of operating costs to come from operating revenues, leaving 65 percent to be subsidized.[2] However, MTC argued that the railroad should bear some portion of the operating deficit. A later MTC report expressed the opinion that "While SPTC should not be expected to continue to bear the entire operating deficit, there are valid reasons for assuming SPTC should bear some portion of it."[3] SP saw no reason that it should bear any of the deficit and made it clear that its preferred course of action was abandonment of the service.

2. Designation of a public entity to negotiate with SP and coordinate the upgrading effort was needed. Public funds for service improvements could not be granted directly to the railroad, a private corporation. While the PENTAP report suggested a number of possibilities (Caltrans, the MTC with expanded powers, one or more of

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[1] Letter of Transmittal, John Beckett (PENTAP Committee Chairman) to Louise Giersch (Chairman, MTC) in Interim Report on Financing Southern Pacific Rail Service, MTC, September 1, 1978.

[2] San Francisco Bay Region Transit Financing Study, MTC, Berkeley, CA., January 10, 1977.

[3] Interim Report on Financing Southern Pacific Rail Passenger Service, MTC, September 1, 1978.

the local transit districts, or a new entity) it was not clear which of these might be most suitable.

3. SamTrans and the other public agencies realized that they had neither the funds nor the expertise needed to acquire and operate commuter rail service.[1] Negotiation of a purchase-of-service agreement with the railroad, as recommended by the PENTAP report, appeared to be the best and perhaps the only way to insure continuation of the service. However, Southern Pacific remained opposed to anything less than complete abandonment of passenger service, and between 1975 and 1978 SP proposed several schemes to provide alternative transportation for commuters so that service could be discontinued.

4. Despite the gasoline shortage of 1973-1974, which produced a mere 1 percent ridership increase in 1973, SP ridership continued to decline. Several fare increases during the early and mid 1970's were a factor in these losses of ridership. The nearly unbroken decline of ridership since the late 1960's tended to support SP's contention that the service was no longer needed for the "public convenience and necessity," and should be discontinued because of its adverse impact on intrastate and interstate commerce (i.e., freight operations). In addition, the Peninsula transit agencies knew that it would be politically difficult to justify the large expenditures needed to improve rail service if there was no prospect of increasing ridership. For those reasons, the PENTAP report did not recommend extension of the SP terminal further toward downtown San Francisco until a decision on the future of the service had been made. Proof that the decline in ridership could be halted and the downward trend reversed with feasible measures was necessary before any comprehensive upgrading program could begin.

B. Development of the Fare Stabilization Program

1. Southern Pacific's Efforts to Abandon Service

In August 1974, SP filed an application with the CPUC for a

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[1] In 1975, SP offered to sell part of its right-of-way from San Jose to San Bruno as well as a branch line from San Bruno to Daly City (the BART terminus), and all its rolling stock to the MTC for $200 million. This and other plans suggested by SP to replace and abandon passenger service in the West Bay corridor were rejected by the Peninsula transit agencies and MTC.

fare increase of 111 percent, which they claimed would allow them to break even on the commuter service. At hearings during July of 1976, SamTrans objected to this enormous increase, though admitting that SP was entitled to some fare relief. But SP reiterated opposition to subsidies and any purchase of service agreement; SamTrans countered by suggesting the bulk purchase plan (later to become the Fare Stabilization Program), which it discussed with the CPUC.

During the 1974-1977 period, SP made it clear that it wanted to abandon its passenger service. In addition to applying for the enormous fare increase, the railroad presented several proposals for alternative means of providing commuter service which would allow SP to abandon its last remaining commuter operation. In December 1975, SP offered to sell a portion of its right-of-way and one track from San Bruno to San Jose, along with the commuter rolling stock, to the MTC for $200 million. SP was also willing to sell a branch line that would connect San Bruno with Daly City, location of the Peninsula BART terminus. The MTC refused the offer. In August 1976 the railroad offered to provide vans for Peninsula commuters as an alternative to rail service; the MTC and local transit agencies found this unacceptable. A similar proposal by SP in July 1977, offering $8 million to the San Mateo and Santa Clara County Transit Districts for purchase of buses on the condition that SP be permitted to abandon service, was also rejected.[1]

Meanwhile, SP actively sought abandonment of the service. In December 1976, the railroad rejected Alternative B recommended by the PENTAP report, which called for upgraded commuter rail service. Citing the incompatability of increased passenger service with freight operations, SP found the proposal "impractical from a physical and economic standpoint," and warned that "the economy and employment of the Peninsula would be most adversely affected."[2] SP insisted upon a complete separation of passenger and freight services:

> "It is more obvious than ever before that Southern Pacific's freight services must be completely independent of any plans for future passenger transit services."[3]

Southern Pacific also made the argument (which later became the basis of its petition to abandon service) that the

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[1]Letter, A. D. DeMoss (SPTC) to Robert W. Naylor, Chairman, SamTrans Citizens Advisory Committee, September 23, 1976; and A. D. DeMoss testimony before California State Assembly Transportation Committee, December 2, 1977, San Jose.

[2]Letter, Alan DeMoss (SP) to John Beckett, Chairman, PENTAP Committee, 12/14/76.

[3]Letter, Alan DeMoss to Paul Watt, Chairman, MTC, 11/29/76.

Peninsula commuter service was steadily losing ridership and would continue to do so because "it is obvious that the fixed rail commuter system is not what the public wants... Peninsula travelers prefer the convenience of door-to-door service by motor vehicles."[1] For that reason, SP asserted that its commute service was no longer essential to public convenience and necessity, and should be discontinued and replaced with buses and/or vanpools, which were more fuel efficient and cheaper to operate.

Finally, SP made the point that proceeding with an effort to upgrade service would not increase ridership, since the public had decided to commute by auto:

> "Alternative B focuses on a fixed rail, peak hour commute system which has proven to be a failure in attracting the public from the freeway. In fact, the public continues to leave our economical, reliable, and safe commute system for the automobile and other modes...there is no evidence that increased rail passenger service will attract any additional increase in rail patronage."[2]

On May 19, 1977, noting that no decision had been made on its application of August 1974 for increased fares, and claiming an operating loss of over $9.4 million on the service in 1976, SP petitioned the CPUC for permission to abandon the Peninsula commuter service. On July 12, 1977, the CPUC criticized SP's request (filed in 1974) for a fare increase of 111 percent as "tantamount to abandonment," and granted a fare increase of 25 percent (effective August 6, 1977), which the railroad denounced as "completely unfair and unreasonable." Consequently, when the CPUC failed to consider SP's abandonment petition promptly, on November 15, 1977 Southern Pacific petitioned the Interstate Commerce Commission for permission to discontinue the Peninsula commute service in accordance with a provision of the Interstate Commerce Act (49 U.S.C.13(a)2). This provision of ICC law provided that in the event that a state regulatory authority (in the case, the CPUC) failed to act finally on such an application within 120 days of filing, the applicant (SP) could file a similar petition with the ICC, which would assume jurisdiction for the case.

It continued to appear unlikely that the CPUC would allow abandonment of the service, unless the railroad could prove that its intrastate freight services were operating at a loss, which was virtually impossible (SP was and is one of the most

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[1]Letter, DeMoss to Watt, November 29, 1976. During CPUC testimony SP presented estimates that Peninsula rail ridership would decline to 12,000 two way trips by 1980.

[2]Letter, A. DeMoss to John Beckett, December 14, 1976.

most profitable railroads in the U.S.). However, the outcome of the ICC petition was much less certain. Two CPUC commissioners who dissented with the majority opinion on the fare increase felt that the ICC might permit abandonment:

> "Danger to commute interest comes from the real possibility that the ICC may require the abandonment of train commute service because it finds the present intolerable situation consititutes an 'undue burden on interstate commerce.' From our involvement in this case, we have seen nothing which could be used to prove the ICC wrong in taking this unfortunate action."[1]

2. <u>SamTrans' Objections to Abandonment of Rail Service</u>

In testimony before the CPUC on Southern Pacific's abandonment petition on July 18, 1977, SamTrans' General Manager John Mauro outlined the Peninsula transit agencies' objections to the petition, and contested some of SP's assertions about the impacts of abandonment. The most important objections to abandonment were the following:

1. Mauro contended that "the consequences of discontinuance would be to divert a large block of present rail riders to automobiles rather than buses." SP had argued that almost all present SP riders would use buses in the event of abandonment. However, various surveys (including one commissioned by SP), indicated that at least 58 percent of current rail users would attempt to make the trip by auto if rail service ended.[2] Since most of the additional vehicular use (about 2,500 added autos) would occur during peak hours (roughly 62% of SP ridership occurs in peak periods), peak hour traffic congestion would worsen significantly at key interchanges, increasing energy use and emissions in existing air quality non-attainment areas.

2. SamTrans rejected SP's plans to replace train service with buses, arguing that buses were inadequate replacements for the trains for several reasons. First, it was argued that rail service is clearly superior to buses for the movement of large peak-hour volumes. Trains offer much greater capacity than buses, and can be expanded incrementally to meet demand at nominal cost by adding cars.

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[1]Alan DeMoss to California State Assembly Transportation Committee, December 2, 1977.

[2]Pages 7 & 8, California Public Utilities Commission hearings on abandonment of service by Southern Pacific Transportation Company, July 18, 1977.

Complete replacement of rail service with buses was criticized as expensive and impractical. The net operating cost per passenger for bus service (between San Mateo County and San Francisco) would be $1.69, against $1.55 for the SP (1977 cost figures), and as the number of bus riders increased, operating losses (roughly $64,275 per bus per year),[1] would increase incrementally. It was also argued that in terms of logistics it would be nearly impossible to move as many people by bus as by rail. Mauro noted that between 5:00 and 5:30 p.m., it would take at least 58 buses to move the same number of passengers currently carried by SP during that time interval. This would mean loading and moving buses out of the San Francisco terminal approximately every thirty seconds, which would be extremely difficult, especially in view of traffic congestion on US 101.[2]

3. Abandonment of rail service would be contrary to regional transportation, land use, and environmental management plans.

4. Mauro argued that SP's claim that passenger service would restrict the railroad's ability to expand freight service was unfounded. He noted that "it is common knowledge that the railroad operated far more freight service as well as passenger service during World War II than at present over the same tracks without any of this alleged interference."[3]

5. Rail service offers greater speed than bus service because of its private, exclusive right-of-way, and is more dependable (on-time) than buses, which can be trapped in traffic congestion. Mauro noted that speed and dependability were important factors in attracting relatively affluent commuters from San Mateo and Santa Clara Counties, most of whom had access to autos and traveled an average of 25 miles from home to work. Over such relatively long distances, trains were better able than buses to offer high speed service competitive with the private automobile.

6. Most important, Mauro argued that the decline in ridership which the railroad termed inevitable could in fact be reversed. In his opinion, the ridership losses were

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[1]P. 14, Ibid.
[2]P. 18, Ibid.
[3]Testimony of John Mauro, General Manager, San Mateo County Transit District (SamTrans), before the Interstate Commerce Commission, Finance Docket #28611, July 1979, p. 23.

largely the result of SP's failure to do anything to market or improve the service. Since the railroad had refused any public subsidy, there was another way to stimulate patronage: subsidize the riders. This user-side subsidy concept was the basis for the Fare Stabilization Program.

C. Program Planning, Objectives, Problems Resolved and Implementation

SamTrans had initiated efforts to upgrade rail service even before the MTC adopted Alternative B for inclusion in the Regional Transportation Plan. After SamTrans' proposal for negotiations on a purchase of service contract was ignored by the Southern Pacific, in July 1976, SamTrans testified on SP's petition for a 111% fare increase before the CPUC. While objecting strongly to the magnitude of the proposed fare increase, SamTrans acknowledged that SP was entitled to some fare relief. When the railroad reiterated its opposition to subsidies or purchase of service, SamTrans made a counter proposal, which it discussed with PUC officials, for a bulk ticket purchase plan intended to stabilize rail ridership by offering fare discounts, with or without the help of the railroad. Nothing came of this proposal until the MTC acted on the recommendations of the PENTAP report and made plans for implementation.

1. Fare Stabilization Program - Planning and Objectives

In April 1977, the Metropolitan Transportation Commission adopted Alternative B of the PENTAP report. In order to implement this policy, on May 25, 1977 MTC passed Resolution No. 411, which contained an implementation plan for the PENTAP proposals, including guidelines for implementation of its rail element. These guidelines emphasized the preservation of existing services as the most immediate priority. The rail element was to be implemented in three phases:[1]

Phase I - Would maintain existing rail commuter service while introducing a discount fare program and improved downtown San Francisco bus distribution services (operated by the San Francisco Municiapal Railway, or "Muni," the City transit system).

Phase II - Would improve existing service levels and standards of service as provided for by Alternative B under a purchase of service contractual arrangement. The emphasis would be on defining service levels and standards to meet

[1] Interim Report On Financing Southern Pacific Rail Passenger Service, MTC, September 1, 1978, pp. 3-4.

transit requirements, rather than on how the specifics of the transportation services should be developed.

Phase III - Would allow for possible expansion of the improvement program for rail service within the parameters of Alternative B.

This MTC resolution sanctioned SamTrans to proceed with its bulk ticket purchase plan. SamTrans General Manager John T. Mauro, who was principally responsible for developing the program, felt that a discount fare program for SP riders should be implemented as soon as possible because of the imminent threat of a large fare increase which would result in further ridership losses and possible abandonment of the service.

Mauro saw two threats to any effort to upgrade the SP. First, a large fare increase was clearly imminent, and could be expected to lead to further erosion of ridership in the near future. It was also feared that constantly declining ridership over a long period could make costly improvements needed to improve service difficult to justify, and strengthen the railroad's case for abandonment of the service at some future date.

Mauro proposed to organize a "Sam Train Commuter Association" designed to preserve and encourage growth of rail ridership in San Mateo County. Association members (limited to San Mateo County residents) would be eligible for substantial discounts on the purchase of weekly and monthly railroad commuter tickets, and would receive reduced fares on local buses to and from railroad stations in San Mateo County. To provide this discount, SamTrans would purchase commuter tickets at the higher fare approved by the PUC, and sell them to association members at a discount through SamTrans' retail ticket outlets. The cost difference would be offset with Transit Development Act Funds available to SamTrans.

Upon reviewing SP ridership statistics for October[1] 1976, SamTrans found that about 65 percent of rail commuters from San Mateo County (2,536 of 3,901) were buying weekly or monthly commuter tickets. On the basis of that information, Sam Trans estimated that between 2,500 and 3,000 San Mateo County rail passengers would buy either 10-trip weekly or 44-trip monthly commuter tickets at the discount prices.

The size of the discount offered would depend to a large extent on the magnitude of the fare increase granted by the PUC. Assuming that the PUC granted a 40 percent fare increase, it was recommended that SamTrans provide a 30 percent discount

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[1]Sam Trans staff report on Southern Pacific Railroad Peninsula Commuter Service, May 21, 1977, p. 4.

to members of the Sam Train Commuter Association who bought weekly or monthly commuter tickets. The SamTrans Board approved $600,000 for the fare stabilization program during 1977-78, enough to provide 7,900 discount rides a day, or two daily trips for each San Mateo County commuter.[1]

2. Obstacles To Implementation of Fare Stabilization Plan

The Fare Stabilization Program proposed was reviewed at a meeting in late 1976 with SP officials who raised various legal and technical questions over the role of SP in such a program. Although SP officials doubted that the program would work, they did not oppose it, since it would not cost the railroad any money (SamTrans assumed most of the administrative tasks and agreed to reimburse SP for handling tickets). However, several issues needed clarification:

1. California Public Utilities Code (Section 522) did not allow common carrier tickets to be resold at a discount. SP feared that it might be subject to criminal penalties if the discount fare plan was implemented without changing the law.

2. SP had doubts that SamTrans or the other transit agencies had legal authority to sponsor such a program or to negotiate and conclude a purchase of service contract.

3. The railroad was not certain that the transit agencies had a secure source of funds for the program. SamTrans proposed to use San Mateo County's surplus of funds from the Transit Development Act (TDA), a State law which reserved one-quarter of one percent of the value of taxable sales in the San Francisco Bay region for improved coordination of regional transportation services. As TDA funds had been appropriated since 1972, and SamTrans only began operating service in 1976, by 1976-1977 a surplus of about $12 million had accumulated.

In the past, TDA funds had usually been granted to publicly owned bus systems operated by municipal transit districts. Since the transit agencies on the Peninsula did not own railroad facilities and had no control over SP's operations, it was not clear that TDA funds could be used by a city or county to subsidize patrons of a privately owned and operated transportation system.

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[1]Sam Trans staff report on Southern Pacific Railroad Peninsula Commuter Service, May 21, 1977, p. 4.

Southern Pacific demanded clarification of these issues before participating in the program, and strongly suggested that special legislation would be necessary. These objections caused nine months' delay in implementing the program as SamTrans, the MTC, and other transit agencies were forced to seek state legislation to ensure that the program would be legal.

In response to these concerns, in September 1977, a bill (A.B. 1853) was passed in the Legislature with the support of the MTC, Caltrans, SamTrans, other local transit agencies and area legislators (Assemblyman Louis Papan, D-San Mateo, sponsored the bill). A.B. 1853 was the enabling legislation for implementation of PENTAP Alternative B recommendations by local transit agencies. The important provisions of AB 1853, which allowed the Fare Stabilization Plan to proceed, were the following:

1. Section 522 of the California Public Utilities Code, which prohibited common carriers from "directly or indirectly" granting discount tickets for passenger services, was amended to authorize "the legislative body of any city, county, or transit district, located in the area served by the Southern Pacific Transportation Company (SPTC) between San Francisco and San Jose, to make a bulk purchase of tickets for that line from the company...for transportation services within the area, for resale at less than cost to residents of the city, county or transit district."[1] The legislative bodies of the cities or counties concerned were to determine the resale price and the discount; the governing body of a transit district (e.g., the SamTrans Board) was to set the district's resale price. Permission for the bulk purchase and resale of tickets below cost was to extend only until January 1, 1980; the program was not intended to be permanent.

2. The legislation authorized Caltrans to negotiate and, if feasible, contract with SP to provide passenger rail service between San Francisco and San Jose and intermediate points, subject to the funding available and the level of service recommended by the MTC.

3. The law directed MTC to submit a detailed financing plan to meet the goals outlined in the PENTAP study designated for implementation during the first two years by the study recommendations, by February 1, 1978. A similar plan for implementation of study recommendations after the first two years was to be submitted by September 1, 1978. This provision was

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[1]Assembly Bill 1853, Chapter 1216, Sections 2 and 5.

partially in response to SP's concern that any subsidy program would not have a confirmed long-term source of funding; some legislators also requested more detailed financial plans.

4. Section 7 of Chapter 1216, Statutes of 1977 (AB 1853) amended Section 99260.5 of the Public Utilities Code to allow claims for Transportation Development Act (TDA) funds to be filed by counties and cities, as well as public transit agencies for payments to a railroad corporation subject to PUC jurisdiction to offset operating losses incurred in transporting passengers within, to, or from the jurisdiction(s) concerned. The bill also stipulated that claims for railroad operating subsidies made against TDA revenues must be used only for support of passenger rail operations. These provisions clearly authorized transit districts, cities, or counties to utilize TDA funds to subsidize passenger rail service in the West Bay corridor.[1]

A number of administrative problems also had to be resolved prior to initiation of the Fare Stabilization Program:

1. Arrangements had to be made for the sale of discount tickets and for reimbursement to riders (if they paid the full PUC approved fare), or to SP (if they paid only the discount fare) since Southern Pacific refused to handle any reimbursements to passengers. SamTrans felt that issuing cash or checks (worth roughly $50,000/month) directly to riders, based only on proof of ticket purchase, would be prone to abuse.[2] Furthermore, the program was to be restricted to County residents (i.e., taxpayers) only; Santa Clara County and the City and County of San Francisco later set up comparable programs (the Santa Clara County fare discount plan is still valid for intra-county travel on the railroad). Reimbursement by check directly to riders would have been costly and time consuming, and would not have resolved the problem of limiting sales to bona fide County residents.

Southern Pacific predicated its participation in the Fare Stabilization Program on certain other conditions:

1. The railroad insisted that it receive the full CPUC

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[1] Interim Report on Financing Southern Pacific Rail Passenger Service, MTC, Berkeley, CA, 9/1/78.

[2] Letter from Robert Naylor, Chairman, Citizens Advisory Committee San Mateo County Transit District to John T. Mauro, Sam Trans General Manager, 9/7/77.

approved fare before any ticket was used for travel (i.e., instant reimbursement from SamTrans).

2. Southern Pacific insisted that the contract specify that SP would "incur no risk or liability of any kind for any tickets sold to commuters holding "Sam Train" cards or such other identification as SamTrans might require." SamTrans would accept all responsibility that all the parties complied with all applicable laws governing bulk purchases of tickets and later resale at a discount.[1] (Passage of AB 1853 eliminated this problem by legalizing the discount).

3. Since distribution of tickets would be performed as a service for SamTrans by SP ticket offices, the railroad expected SamTrans to pay for all costs of resale and distribution (including related administration and accounting costs), with the specific level of cost reimbursement to be negotiated.

4. Southern Pacific would distribute tickets only at existing ticket offices; if SamTrans desired distribution at additional outlets or at agencies which SP wished to close, "full labor and related facility costs associated with such retained personnel would be borne by SamTrans."[2]

A.B. 1853, which removed most obstacles to the discount ticket plan, became law on October 1, 1977; its provisions, which would allow implementation of the fare stabilization program, were to become effective on January 1, 1978. Negotiations between SamTrans and Southern Pacific during the summer and fall of 1977 were successful in resolving remaining issues, and an agreement to implement the fare stabilization program (beginning on January 1, 1978) was signed by SamTrans and Southern Pacific on December 12, 1977.

4. Program Implementation and Operations

The mechanics of the Fare Stabilization program were designed to minimize administrative costs and problems, addressing SP's concerns about arrangements for ticket sales and reimbursement. The program was organized and functioned along the following guidelines:

1. The program allowed SamTrans to reserve any number of five and seven day monthly tickets, twenty ride family

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[1]Letter, J.H. Williams (SPTC) to John Mauro (SamTrans), October 17, 1979, p. 2.
[2]Letter, Williams to Mauro, October 17, 1977.

tickets, and student weekly or monthly tickets from SP for sale to San Mateo County residents at a discount. Tickets were sold at a 30 percent discount through Southern Pacific's ticket offices, and SamTrans agreed to reimbuse SP for the full CPUC fare.

2. Southern Pacific, under contract with SamTrans, sold the commute tickets through their ticket offices at 70 percent of face value. To be eligible for the discount ticket program, residents were required to register with the appropriate county transit agency before purchasing tickets. SamTrans sought to register potential commuter ticket purchasers, in order to identify commuters by name and number in each of SP's four fare zones in San Mateo County. To accomplish this objective, SamTrans published an application form (see Exhibit IX-1) in local newspapers, and SamTrans representatives distributed application forms at SP stations starting several weeks before the program began. Following receipt of an application and verification of the applicant's residency, SamTrans issued a "Sam Train Commuter" card, which had to be presented at SP ticket offices to obtain the discount on commuter tickets.

3. When discount tickets were sold, authorized purchasers (County residents registered for the program) were required to complete a voucher which included the purchaser's "Sam Train" I.D. card number, a description of the type of ticket bought, the date, the signature of the purchaser, and the initials of the ticket agent who verified the identity of the purchaser. Southern Pacific collected the remainder of the ticket price by presenting the completed vouchers for reimbursement at a bank designated by SamTrans.

This ticket distribution scheme, while somewhat complicated, had several advantages. Issuance of I.D. cards enabled SamTrans to verify that purchasers were County residents, as stipulated by A.B. 1853. Completion of vouchers gave SamTrans accurate information about the number and type discount tickets sold, useful in estimating future costs of the discount program. The voucher system also relieved SamTrans of the problem of distributing refunds or reimbursements directly to ticket buyers. Unfortunately, the identification requirements and voucher procedure made it impractical to extend the discounts to one-way and round-trip ticket buyers (who accounted for about 20 percent of total ridership).

SamTrans agreed to reimburse SP for any "demonstrated" additional administrative and accounting expenses for ticket sales, handling and distribution attributable to the Fare Stabilization Program. SamTrans was also allowed to sell tickets at a discount directly to the public through other outlets at its own expense.

5. Marketing of the Program

From the beginning of the program, SamTrans emphasized the crucial role of marketing - informing potential users about the discount fare plan and encouraging them to register for and purchase discount tickets. SamTrans General Manager John Mauro emphasized that the Fare Stabilization Program would be only one element of an overall marketing program designed to increase rail ridership: "...Our purpose in undertaking this program is to demonstrate price incentives as a key ingredient in an overall, intensified marketing effort designed to halt the decline of rail ridership."[1]

The initial marketing effort had two elements. First, a large-scale effort was made to inform current and potential users about the fare discount available and to encourage them to register for the program. To accomplish this, SamTrans ran advertisements in local newpapers (see Exhibit IX-1), explaining the program and registration procedures, and including a registration form which could be used to apply for the necessary "Sam Train Commuter" I.D. card. SamTrans representatives also appeared in stations and rode trains to answer questions, distribute registration forms, and encourage passengers to take advantage of the program. According to Maureen Hennessey of the SamTrans Marketing Department, this campaign to "meet the riders" was the most effective and least expensive tactic used to encourage participation.[2]

Concurrently with commencement of the Fare Stabilization Program, the SamTrans Board of Directors authorized free local bus rides to and from Southern Pacific stations in San Mateo County to "Sam Train" card holders. This measure was intended as an incentive to promote maximum railroad patronage and to improve access to stations, especially for transit dependent riders. Under the terms of a purchase of service contract with Greyhound, which operates corridor bus service for SamTrans, the District assumed responsibility for setting schedules and fares on bus service on July 2, 1977. This permitted Sam Trans to improve bus/rail coordination and connections. However, since most existing and planned Sam Trans routes served SP stations (which tend to be located in downtown, urbanized parts of the corridor), route changes needed to improve bus/rail connections were minimal and cost very little. Unfortunately,

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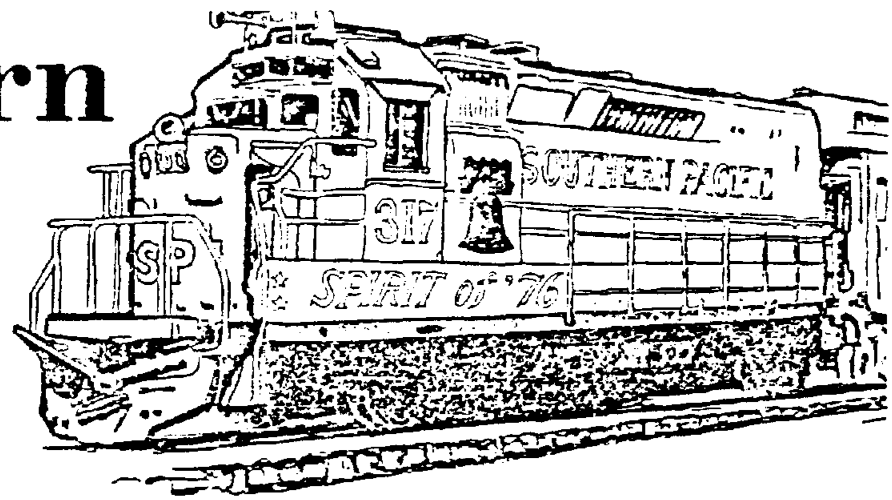
[1]Letter, J.T. Mauro (SamTrans) to A.D. DeMoss (SPTC), October 3, 1977.

[2]M. Hennessey, SamTrans Marketing Dept., conversation with R. Leyshon, September 18, 1981.

Exhibit IX-1

Southern Pacific riders:



samTrans has a plan to cut your commute costs by 30 per cent!

Be a SamTrain Commuter, and save 30 per cent on weekly, 20-trip, monthly, or student rail tickets.
Ride free to and from your local train depot on a SamTrans bus. Other benefits to be announced. Fill out the coupon below for your SamTrain Commute Card. Offer open to all San Mateo County residents.

I WANT TO BE A SAMTRAIN COMMUTER

As a resident of San Mateo County, I wish to join the San Mateo County Transit District in its campaign to preserve rail passenger service by the Southern Pacific Railroad between San Francisco and San Jose.

It is my understanding that my SamTrain Commuter Card will enable me to:

—Obtain free bus service immediately on SamTrans buses to and from Southern Pacific stations in San Mateo County

—Effective January 1, 1978, and until further notice, purchase weekly, 20-trip or monthly rail tickets from SamTrains at a discount of 30% per ride

—As soon as arrangements can be completed, obtain free bus service on San Francisco Municipal Railway buses to and from the Southern Pacific's Fourth and Townsend Street station in San Francisco

—Receive schedule information and other transportation news from SamTrans.

As a guide for Samtrans ticket allocation, I plan to purchase:

☐ 20-trip family ticket
☐ 7-day monthly ticket
☐ 5-day monthly ticket
☐ Weekly ticket ☐ Student ticket

For trips between ____________ and ____________

____
(name)

____
(street)

____
(city and zip code)

____
(telephone)

Please mail to:
SAMTRAIN COMMUTER
400 S. El Camino Real
San Mateo, California 94402

Do not send money with this application. Further details will follow with your SamTrain Commuter card.

Proof of residency required. Please send with application a photocopy of either an auto registration, driver's license or tax receipt.

samTrans • 367-1500 • 348-8858 • 871-2200

efforts to arrange free rides on San Francisco Municipal Railway (Muni) buses to and from the SP's Fourth and Townsend Street station in San Francisco for Sam Train commuters were unsuccessful.

As SP ridership stabilized in late 1978 and began to increase more rapidly in 1979, State and local government agencies developed other marketing programs. In early 1977, under Section 9 of S.B. 283 (which had authorized the PENTAP report) the Secretary of Business and Transportation granted Caltrans $137,000 to market the Southern Pacific service on the Peninsula. Caltrans entered into a three-party agreement with SamTrans and the Santa Clara County Transit District to coordinate marketing of the service.[1] The agencies first developed a media support program for their "cost per mile" marketing effort in April and May of 1979, using freeway billboards, as well as newspaper and radio advertisements. This campaign was intended to encourage the public to consider the alternative of commuting on the SP, emphasizing that the cost per mile (about 3.5-4 cents) was much lower than for driving.

Another marketing program involving Caltrans and the Peninsula transit districts was a one-month demonstration project which offered a 40 percent discount on one-way and round-trip tickets during September, 1979. Media support for this program included local newspaper and radio advertisements on August 20, 1979 and ran for one month. During the summer of 1979 Caltrans also entered into another marketing contract with the San Francisco Municipal Railway (SF Muni) to encourage use of the Peninsula rail service by improving bus connections to the downtown area. This three-month program started in July, 1979, and provided frequent shuttle bus service between the SP station and the Civic Center area. In September, 1979 Caltrans also collaborated with Muni in publishing a brochure that highlighted all Muni routes that served the SP Terminal.

6. Program Implementation Costs

MTC allocated TDA funds to SamTrans and the other two transit agencies participating in the Bulk Ticket Purchase Program, and the Phase I discount fare program was based entirely on the use of TDA funds to cover the discount cost. For fiscal year 1977-1978, a total of $1.2 million was budgeted for the Fare Stabilization Program. This cost estimate was based on 1976 passenger origins in each county, with a 40 percent discount provided by the transit agencies to offset an anticipated 40 percent fare increase. SamTrans budgeted $600,000 for the Fare Stabilization Program, the Santa Clara County Transit District

[1] San Francisco Peninsula Rail Survey Report, Caltrans, July 1981, pp. 21-22.

contributed $500,000, and the City and County of San Francisco budgeted $100,000. Since the need for enabling legislation postponed the beginning of the Bulk Ticket Program until January, 1978, the budget for FY 1977-78 was more than adequate to fund the program. Moreover, because the fare increase granted by the CPUC in 1977 was only 25 percent (instead of the expected 40 percent), and the districts provided a 30 percent discount on tickets, program costs were lower than expected in 1977-78 (about $535,692 for SamTrans, based on an average value of discounts of about $44,641 per month).[1]

For fiscal 1978-79, the program budget (based on 1976 ticket sales and anticipating a 15 percent fare increase) was $1.7 million, with $799,000 to be furnished by SamTrans, $863,000 by Santa Clara County Transit, and $92,000 from the City and County of San Francisco. Since fares did not increase during the Fare Stabilization Program, money budgeted in anticipation of increases was available to extend discounts to the unexpectedly large number of commuters who registered for the program, without exceeding the program budget. (Total expenditures forecast in 1978-79 were $1,526,155, including $694,904 from SamTrans, substantially less than the sums budgeted).[2] For SamTrans, the cost of providing fare discounts was $535,692 (an average of about $45,000/month) in 1978, $694,904 in 1979 (about $58,000/month) and about $347,452 during the first six months of 1980 (based on 1979 costs), for a total cost of $1,578,042 to San Mateo County over the duration of the program.

While the precise costs for marketing and administration of the Fare Stabilization Program were not available, these costs were described as modest. An idea of program marketing costs is given by Sam Trans' expenditures for advertising the Southern Pacific service in 1981, (including newspaper ads, radio spots, and billboards), which were estimated at $62,696.[3]

7. Problems Unresolved and Criticisms of the Program

The major criticism made of the Fare Stabilization Program was the contention by transit dependent groups that the 30 percent fare subsidy, which applied only to weekly, monthly, and 20-ride commutation tickets, was inequitably distributed because the major beneficiaries were middle and upper-income commuters, while most transit dependents were from low income groups and only occasional users. As required by S.B. 283 and

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[1]Computed using data from Table 1.4, FEIS, p. 1-14 and Financing Plan for Phase I of the PENTAP Study, MTC, Berkeley, CA, January 25, 1978, pp. 5-6.
[2]Financing Plan for Phase I, Table 1.
[3]"Rail Fare Analysis Report", SamTrans, September 3, 1981, Attachment "A".

AB 1853, the PENTAP Transit Dependent Study, conducted by the MTC and completed in December, 1978, examined the existing and potential utilization of SP service by transit dependent groups (including the elderly, handicapped, minority and low-income populations) on the Peninsula. A survey of transit dependent persons conducted by the study found that 60 percent of them had never used the railroad during the previous year, and another 16.5 percent had used it only occasionally (once or a few times during the year). Of the transit dependent group as a whole, only 22.2 percent of the respondents indicated that the Southern Pacific was their usual means of making the journey to work (contrasting 81 percent of the non-transit dependent respondents, who used the service for commutation). Among the minority (23.5 percent) of the transit dependent who rode the trains more than occasionally, 42 percent (or about 10 percent of the total transit dependent population) said they used the service to travel to work, though not necessarily on a daily basis.[1]

Among the majority of transit dependents surveyed (60 percent) who had never used the SP, the major reasons given for not using the service were lack of information about the service (mentioned by 25 percent), service not provided to chosen destinations (20 percent), and residential location too far from any station (14 percent). Only 8 percent of the transit-dependent non-users surveyed mentioned high fares as an important reason for not using the railroad. Forty-five percent of the transit dependent group as a whole (SP users and non-users) felt that SP did not serve their needs at all, and 55 percent said they were not likely to make the journey to work by train citing infrequent, circuitous and slow feeder bus service as the major access problems.

Despite the relatively low level of rail service utilization by the transit dependent, the study indicates that in discussions with transit dependent groups, "it was clear that (1) promotion of SP use among transit dependents with marketing and information would not be successful unless fares for casual use were lowered, and (2) the current subsidies and discounts for regular commuters were thought to be inequitable."[2]

It is true that Southern Pacific single ride fares were (and are) substantially higher than monthly or weekly commuter tickets on a cost per ride basis. For example, a regular commuter from Menlo Park to San Francisco paid $1.26 per ride

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[1]PENTAP Transit Dependent Study, A Study of the Southern Pacific Peninsula Service and the Transit Dependent Community, MTC, December 1978, p. 33.
[2]Ibid., p. 35.
[3]Ibid., p. 36.

rather than the single ticket price of $2.55; addition of the 30 percent fare discount made the net cost to the commuter only $.88 per ride (see Table IX-4).[1] However, while the inequity of the fare structure to occasional users was exacerbated by the additional commuter ticket subsidy provided by the Fare Stabilization Program, it is not clear that the program discriminated against transit dependent groups as a whole, and certainly did not do so deliberately.

8. <u>Termination Of The Fare Stabilization Program (August 1, 1980)</u>

On July 2, 1979, the ICC Administrative Law Judge (ALJ) ruled on Southern Pacific's petition to abandon Peninsula passenger service. The ALJ held that SP was not obligated to pay for the entire cost of commuter operations. In fact, he ruled that the local transit districts should pay the full (avoidable) costs associated with any service provided. He also found that discontinuance would have no "unwarranted impact on the quality of the human environment."[2] Most important, he concluded that since the railroad could not be obligated to pay the costs of service indefinitely, if no agreement was reached on a subsidy arrangement in six months, continued operation by SP of the service would constitute an unreasonable burden on interstate commerce, and public convenience and necessity would permit discontinuance of the service.

This decision, which meant that SP could abandon service in 6 months unless the local transit agencies and Caltrans supplied sufficient funds to cover service costs (about $12 million in 1978), aroused vehement opposition from local government agencies, political leaders and community groups. The decision also put pressure on SP (which had been instructed to "bargain in good faith" with the transit agencies in the ICC decision), and on Caltrans to reach an agreement. Negotiations led to a purchase of service contract agreement between Caltrans and SP in May of 1980. The indirect subsidy provided by the Fare Stabilization Program (which had been extended for a year in January 1980), was replaced by a direct subsidy to the railroad, which (as stipulated in the ICC decision) was much more costly. Consequently, the Fare Stabilization Program was phased out in 1980 and the funds used for the service contract.

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[1] Ibid., p. 36.
[2] <u>Appelate Brief of the San Mateo County Transit District</u>, Finance Docket #28611 before the Interstate Commerce Commission, San Francisco, California, August 15, 1979, p. 2.

TABLE IX-4

San Mateo County Transit District
Comparison of Southern Pacific Fares With and Without Sam Trans 30% Discount

Between San Francisco and	Type of Ticket	SP Fares As of 8/1/77	Approximate Cost per Ride	With SAMTRANS 30% Discount[1]	Approximate Cost per Ride	One-way Fare As of 8/1/77
Zone 1						
Butler Road	Monthly (40/month)	$33.75	$ .84	$23.65	$ .60	$1.45
South S.F.	Monthly (60/month)	36.55	.61	25.60	.42	
San Bruno	Weekly (14/week)	9.70	.70	6.80	.48	
Millbrae	20-Ride	29.40	1.22	17.10	.85	
Zone 2						
Broadway	Monthly (40/month)	$39.40	.99	27.60	.69	$1.70
Burlingame	Monthly (60/month)	42.80	.71	29.95	.50	
San Mateo	Weekly	11.05	.79	7.75	.55	
Hayward Park	20-Ride	27.90	1.39	19.55	.98	
Zone 3						
Hillsdale	Monthly (40/month)	45.00	1.12	31.50	.79	$2.10
Belmont	Monthly (60/month)	49.05	.81	34.35	.57	
San Carlos	Weekly	12.50	.89	8.75	.62	
Redwood City	20-Ride	31.45	1.57	22.00	1.10	
Zone 4						
Atherton	Monthly (40/month)	50.60	1.26	35.40	.88	$2.55
Menlo Park	Monthly (60/month)	55.30	.92	38.70	.64	
	Weekly	14.60	1.04	10.20	.72	
	20-Ride	36.60	1.83	25.60	1.28	

[1] Discount program terminated on 8/1/80 after Caltrans and SP negotiated a long-term purchase-of-service agreement.

SOURCE: San Mateo County Transit District

IV. PROGRAM OPERATIONS AND IMPACT ANALYSIS

A. Registration For The Fare Discount Program

SamTrans and the other two local transit agencies sponsoring the Fare Stabilization Program began campaigns to register residents of their respective counties for the discount in October 1977, while waiting for A.B. 1853 to become effective on January 1, 1978. Application blanks were disseminated through newspaper advertisements, and by SamTrans representatives at SP stations.

Response to the registration program for the fare discount exceeded all expectations. By early April, 1978, more than 5,300 San Mateo County residents had applied and qualified for the discount on commuter rail fares. (About 4,600 residents of Santa Clara County applied for a similar discount program.) More people registered for the program than were riding the trains at the time (about 3,500 each way in San Mateo County alone), indicating the potential for increased ridership. Over 13,000 discount tickets were sold in San Mateo County by early April 1978, after only three months of the program. As of September 8, 1978, 6,700 San Mateo County residents had registered for the program, more than double SamTran's estimate of 2,500 to 3,000.[1] The marketing efforts described in the previous section were an important factor in the success of the registration program and of the fare discount plan.[2]

B. Impact Of The Fare Stabilization Program On Ridership

Table IX-5 presents ticket sales statistics for the 1977-1981 period. Yearly totals for 1977 and 1980 (before and after the Fare Stabilization Program) indicate that both total and commuter rides sales increased by 42 percent. However, the pattern of these increases is noteworthy. Between 1977 and the end of 1978, the first full year of the Fare Stabilization Program, commuter rides rose by 1.7 percent, and total rides by only .5 percent, while one-way and round trip rides decreased by 8.6 percent. Most of the overall ridership increase occurred during 1979 and the first seven months of 1980, prior to

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[1] Final Environmental Impact Statement, Finance Docket 28611, Petition of Southern Pacific Transportation Company for Discontinuance of All Passenger Train Service Between San Francisco and San Jose, California, Interstate Commerce Commission Office of Proceedings, Washington, D.C., 10/31/78, page 1-21.

[2] The ICC Final Environmental Impact Statement (hereafter ICC FEIS) noted that "The success of the program registration and any subsequent increases in ridership may be attributed to the marketing of the fare plan, to some extent, as well as to the actual discount offered." (ICC FEIS, page 1-12).

TABLE IX-5

Southern Pacific Railroad Peninsula Commute Service
Monthly Ridership Data (Based of Ticket Sales) and Important Events, 1977-1980

	Commute Rides Sold--1977	Commute Rides Sold--1978	Commute Rides Sold--1979	Commute Rides Sold--1980	Commute Rides Sold--1981
Jan.	318,698	(2) 327,432	351,780	471,172	417,842
Feb.	291,430	327,432	307,102	440,376	386,586
Mar.	348,190	336,270	(3) 350,656	460,352	436,626
Apr.	304,940	301,748	353,298	464,436	424,256
May	323,466	333,432	429,306	455,970	394,412
June	309,990	301,248	391,254	440,780	
July	295,602	292,964	420,344	(4) 467,864	
Aug.	(1) 306,628	310,984	410,468	360,390	
Sept.	295,578	287,408	364,077	409,178	
Oct.	297,078	334,540	472,232	439,672	
Nov.	300,004	317,370	440,796	386,654	
Dec.	272,392	293,068	387,214	394,740	
TOTALS	3,663,996	3,726,864	4,678,527	5,191,584	
% Change		+1.7%	+25.5%	+10.9%	

	One Way & Round Trip Rides Sold 1977	One Way & Round Trip Rides Sold 1978	One Way & Round Trip Rides Sold 1979	One Way & Round Trip Rides Sold 1980	One Way & Round Trip Rides Sold 1981
Jan.	53,941	(2) 66,442	53,173	74,171	85,240
Feb.	47,032	50,188	45,193	62,260	69,716
Mar.	53,518	58,258	(3) 54,530	72,398	93,219
Apr.	43,838	49,246	78,884	74,921	91,898
May	53,955	54,560	136,188	73,623	93,065
June	55,795	55,739	98,276	76,959	
July	67,388	55,536	108,257	(4) 86,672	
Aug.	(1) 86,398	59,834	114,374	89,510	
Sept.	67,710	54,464	111,173	81,241	
Oct.	67,982	57,677	89,246	89,579	
Nov.	72,009	62,409	83,326	104,388	
Dec.	76,223	56,809	84,793	94,467	
TOTALS	745,789	681,152	1,057,413	980,189	
% Change		-8.6%	+55.2%	-7.3%	

	Total Rides Sold--1977	Total Rides Sold--1978	Total Rides Sold--1979	Total Rides Sold--1980	Total Rides Sold--1981
Jan.	363,544	(2) 386,356	403,074	541,703	498,605
Feb.	331,054	333,559	348,883	500,648	450,985
Mar.	394,338	388,750	(3) 400,195	531,418	523,268
Apr.	352,375	344,392	430,082	536,858	514,464
May	369,869	383,148	562,058	526,448	478,722
June	357,862	351,601	489,530	504,846	
July	353,214	342,889	517,960	(4) 550,445	
Aug.	(1) 382,831	366,342	522,446	445,774	
Sept.	349,558	336,367	475,716	484,225	
Oct.	356,297	386,332	558,965	522,870	
Nov.	367,033	378,230	521,976	485,118	
Dec.	341,998	343,045	468,565	482,537	
TOTALS	4,319,973	4,341,011	5,699,406	6,112,890	
% Change		+0.5%	+31.1%	+7.25	

Events 1977-1980 Event	Date	Ridership Changes* Commute	O.W./RT	Total
(1) 25% Fare Increase	(8/6/77)	- 3.6%	-21.6%	- 8.7%
(2) Start of Fare Stabilization Program	(1/1/78)	+20.2%	-12.8%	+12.9%
(3) Gasoline Shortage (4/79-8/79) and Price Increase	(4/79-5/80)	Depends on interval selected		
(4) Fare Stabilization Program Ends	(1/8/80)	-22.9%	+ 3.2%	-19.0%

*Monthly ridership change between the month before the event and the month after.

the end of the Fare Stabilization Program on August 1, 1980. Between 1978 and 1979, commuter rides rose by 25.5 percent, total rides by 31.3 percent, and one-way and round trip rides by 55.2 percent. During the first seven months of 1980 (compared with the same period in 1979), commuter rides increased 23 percent, one-way and round trip rides decreased by 9.3 percent, and total rides increased 17 percent (see also Figures IX-1 and IX-2).[1]

This pattern of ridership increases indicates that much of the overall ridership increase between 1977 and 1980 cannot be attributed solely to the Fare Stabilization Program. The largest ridership increases occurred between April 1979 and July 1980, during and in the year after the gasoline supply shortages of April-July 1979, and coinciding with roughly a 50 percent increase in the price of gasoline between mid-1979 and mid-1980. In fact, the concurrence of the Fare Stabilization Program, gasoline shortages, and large gasoline price increases during 1979-1980 make it extremely difficult to measure the influence of any one factor on ridership growth with any certainty, particularly after March 1979.

1. Ridership Trends, 1979-1980

In a March 1980 survey of Southern Pacific passengers conducted by Caltrans, 62 percent of respondents cited travel cost savings and 50 percent cited the high cost of gasoline as the most important reason for using the train. While the marketing effort associated with the Fare Stabilization Program probably helped to build ridership during the gasoline shortage and price increases of 1979-1980 by increasing awareness of the service as a low-cost commuter alternative, it was probably the interaction of both higher driving costs and the discount fare program that account for the large ridership increases during this period.

Comparison of total rides sold during the 1973-1975 period and in 1978-80 provides evidence of the fare discount program's impact in increasing ridership in conjunction with the gasoline supply shortages and higher prices in 1979. During the October, 1973- April, 1974 period there was a gasoline supply shortfall of 5 to 15 percent, and the average price of gasoline rose from $.40 to $.55/gallon, or 37.5 percent. While it is not possible to compare monthly ridership changes during these periods because the months involved are different, comparison of yearly ticket sales data indicates that rides sold increased only three percent between 1973 and 1974, and decreased 15 percent between 1974 and 1975.

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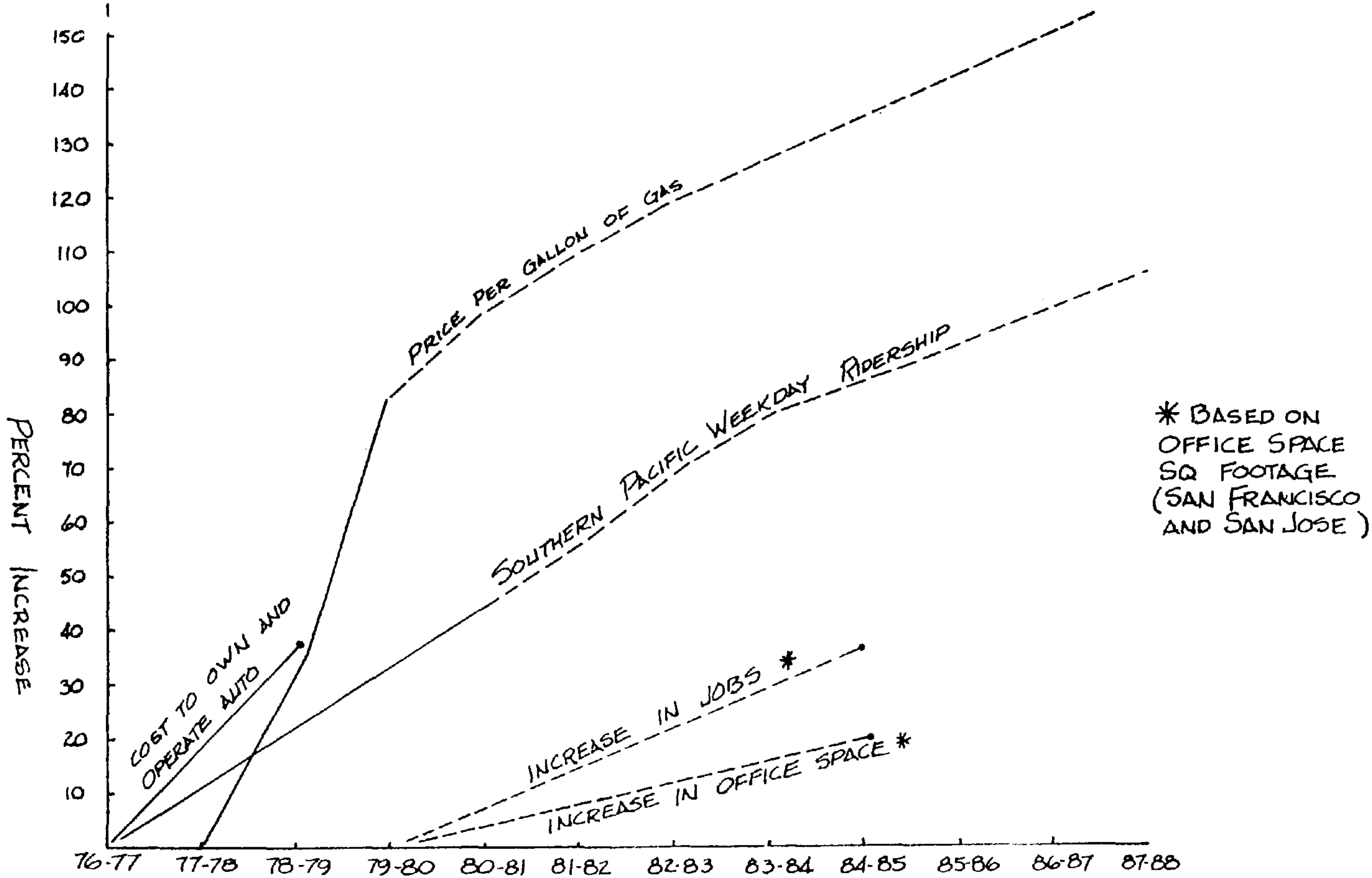
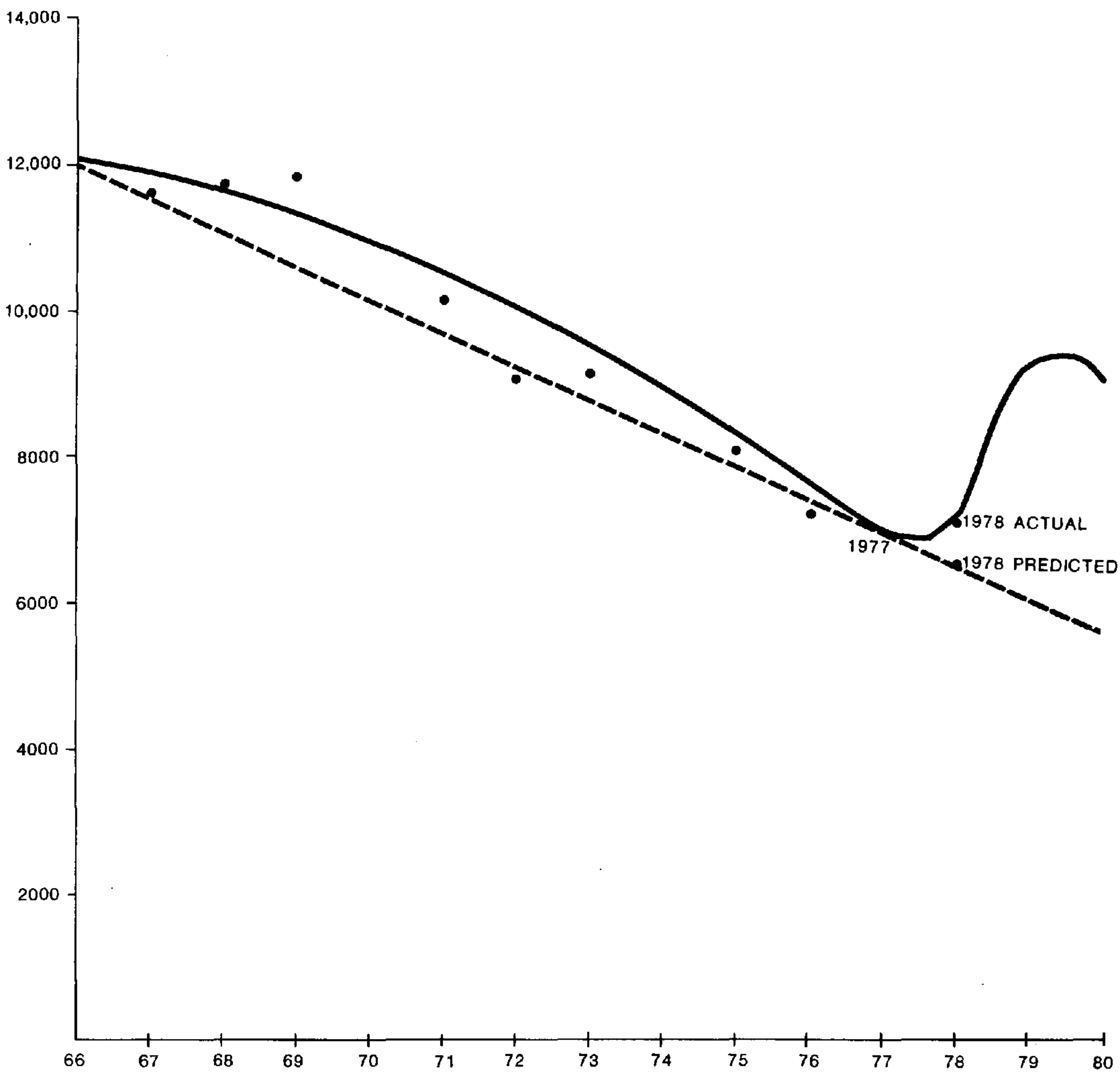
[1]Source of all ridership information: SamTrans.



FACTORS INFLUENCING S.P. RIDERSHIP

ACTUAL ———————— PROJECTED - - - - - - - - - -

Source: SamTrans FIGURE IX-1



LEGEND:

- - - - - PREDICTED TREND LINE

——— ACTUAL RIDERSHIP LINE

Figure IX-2:
SP PENINSULA RAIL SERVICE RIDERSHIP, 1967-1980

BASED ON OCTOBER PASSENGER COUNTS

In contrast, between 1978 (when the fare discount program started) and 1979, total rides increased 31.3 percent. Ridership also increased 7.25 percent between 1979 and 1980 (even though in 1980 there were no gasoline shortages, gasoline prices stabilized, and the fare discount program ended on August 1). This data is indicative of the strong effect of the interaction between the fare discount program and the gasoline shortage and higher prices of 1979 in increasing ridership. The Fare Stabilization Program also appears to account for the larger ridership increase during the 1979 fuel crisis than during the 1973-74 period, and may also be responsible for the smaller, more gradual decline in ridership once the crisis was over.

2. <u>Termination of the Fare Stabilization Program (August 1, 1980)</u>

Upon termination of the Fare Stabilization Program in August 1980, there was a large one-month ridership decrease (-19 percent in total rides and -23 percent in commuter rides between August and September). However, comparing the period after the end of the Program (September-December 1980) with the same four months in 1979, total rides decreased 4.9 percent and commuter rides by 4 percent. Most of the ridership decline observed after the Fare Stabilization Progam ended is attributable to diversion to other modes, although clearly some riders who had bought commute tickets during the program switched to single-ride tickets. Some of the apparent decline may be due not to an actual decline but in the different methods used to count ridership before and after the Caltrans subsidy began. Although ridership clearly declined after the Fare Stabilization Program (by about 5 to 6 percent in total rides and 10 percent in commuter rides based on comparison of the five month January to May period in 1980 and 1981), total ridership was still 36 percent above 1977 levels (comparing January-May 1981 with the same period in 1977) in mid-1981. In the second year of the Caltrans subsidy arrangement, ridership has begun to increase again, however a proposed 25 percent rate increase, now before the CPUC, may reverse this trend.

The most appropriate measure of the program's impact is the change in the number of commuter rides sold, since only commuter tickets were sold at a discount. However, it is also worthwhile to examine the trend in total rides, since the Fare Stabilization Program appears to have affected purchases of both one-way and round trip tickets. While both commuter and single-ride ticket sales increased during the Program, sales of these tickets appear to be inversely correlated.

This pattern indicates that some of those who bought single ride tickets prior to the fare discount program found that they could save money by purchasing commutation tickets at discount prices. While it is not possible to determine the number of existing passengers (as of 1977) who purchased commutation tickets instead of single rides during the fare discount program, it is likely that the number was small, because the situations in which it makes sense to buy commute tickets instead of single ride tickets are limited. (For example, before the program, it was cheaper to buy a weekly ticket than four round trips; with the discount, it became only three round trips, a change that would benefit few riders.) Moreover, survey data in 1977 and 1980 indicate no change in the high proportion of riders (80 percent) travelling five days per week. A more likely explanation of the decrease in one-way and round trip rides is the fare increase of 1977. Single ride ticket sales fell sharply (21.6%) coincident with the fare increase, and it is likely that these riders diverted to SamTrans buses (whose fares did not increase in August, 1977 and were competitive with the increased rail fares), or to other means of transportation.

It is also possible to interpret the observed ridership increases as the result of corridor traffic growth during the 1977-1980 period, indicating that the increase reflects a constant rail share of increasing corridor travel. Based on analysis of Average Daily Traffic (ADTs) on major routes between San Mateo County and San Francisco (U.S. 101, I-280, and California 82), corridor traffic increased only about 5 to 7 percent between 1977 and 1980. This modest increase cannot explain the 42 percent increase in rail ridership during the 1977-1980 period. However, even maintenance of a constant rail share represents a substantial improvement, because as corridor travel has increased and rail ridership decreased over the past twenty years, the rail share of trips has declined significantly. The fact that rail ridership has not declined to the 1977 level even after the end of the program is also significant, perhaps indicative of changing travel habits and attitudes towards mass transit.

Summary

The influence of the gasoline shortage and price increases in 1979-1980 makes the effect of the program on increasing ridership during that period uncertain. On the basis of comparison of analogous time intervals before, during, and after the Fare Stabilization Program, it appears that an increase of at least 1.5 to 2 percent in total rides and 5 to 6 percent in commuter rides can be attributed to the program, based on ticket sales data in 1977 and 1978. While some of the increase in commuter rides is attributable to single ride users buying commuter tickets made more attractive by discount prices, the extent of this shift was small.

C. Other Program Impacts

1. Program Impact on Travel Behavior

The impact of the Fare Stabilization Program on travel behavior (i.e., modal shift from auto to rail) cannot be ascertained precisely, but was probably minimal. While commuter and total ridership increased substantially between the beginning and the end of the program (about 42 percent), the discount fare program was only partially responsible for this increase.

In 1977, about 450,000 person-trips (in both directions) crossed the boundary between San Mateo and San Francisco Counties daily.[1] Of these, approximately 14,400 were Southern Pacific passengers (7,200 in each direction, based on the December 1977 ridership survey), or about 3.2 percent of the total.

Unfortunately, the 1980 survey did not collect information on travel mode or the type of tickets purchased prior to riding the train, so the extent to which auto or bus users shifted to trains in unknown.[2] In any case, this shift was small; even if the total 1977-1980 ridership increase (about 3,000 riders/day) was attributed to the discount program and all of these new riders were previously drivers, the rail share of an estimated 500,000 daily trips in 1980 would only increase to about 20,400, or about 4 percent of total corridor trips.

2. Impact On Vehicle-Miles Traveled (VMT) and Fuel Consumption

Given the relatively small size of the modal shift attributable to the Fare Stabilization Program, it is not surprising that the associated VMT reduction (and related environmental impacts) are also minimal. Estimates of the VMT reduction directly attributable to the program are based on the following assumptions:

1. All of the minimum 2 percent total ridership increase between 1977 and 1978, which amounted to about 70 riders from San Mateo County, can be attributed to the Fare Stabilization Program.

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[1] Ibid., ICC FEIS, pp. 3-11. This total includes trips originating in Santa Clara County, as do SP ridership totals. Santa Clara County operated a fare discount program nearly identical to that in San Mateo County over the same period.

[2] It is clear there was some modal shift because rail patronage increased by over 40 percent between 1977 and 1980, while Average Daily Traffic only increased by 5 to 9 percent over the same period.

2. All new riders formerly made the trip by auto, with average auto occupancy of 1.3.[1]

3. The length of diverted auto trips is approximately equal to the rail distance to San Francisco (this is reasonable, since many SP users are roughly equidistant from Highway 101 interchanges and SP stations).

Using this relationship, the VMT reduction attributable to the program was 2,122 VMT/day (for San Mateo County only). Daily VMT for the three-county area (San Mateo, San Francisco, and Santa Clara Counties)[2] in 1978 was 10,481,000; hence the reduction is .0202 percent of total daily VMT in SP's service area.

The program's impact on fuel consumption is also insignificant, since it is based on the VMT reduction. Using Caltrans suggested 1978 fuel consumption rate of 14.5 miles per gallon, the daily fuel savings attributable to the program is: 2122 ÷ 14.5 = 146 gallons/day or about .005 percent of the three county total in 1976-1977 (2,799,000 gallons/day).

The relatively insignificant magnitude of program environmental impacts is supported by the I.C.C.'s Final Environmental Impact Statement, which found that even in the event that SP service was abandoned, resultant environmental impacts would be minimal. Energy consumption would increase .3 percent, carbon monoxide emissions about .35 percent, hydrocarbon emissions by .12 percent, VMT by 2.1 percent, and about 2,500 to 3,600 autos would be added to peak hour traffic in the three county area.[3] Consequently, even if the Fare Stabilization Program is credited with preventing rail service abandonment (which is debatable), the undesirable impacts on environmental quality and energy consumption prevented would have been minor, because of the small share of rail trips (about 3 to 4 percent) in the regional total. Moreover, the extent of small environmental improvements directly related to ridership gains depends upon the actual number of auto trips replaced, and data on the precise extent of such diversion is not available.

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[1]Vehicle occupancy factor suggested by Caltrans Studies, Cited in ICC FEIS, Page C-1.

[2]An estimate of VMT reduction attributable to the program in the entire three-county area (during 1978 would be:

$$\text{VMT Reduction} = \frac{7200 \times (.02)}{1.3} \times 20 \text{ miles average trips length} \times 2 - 4430$$

or about .042 percent of three county VMT.

[3]ICC FEIS, pages 6-1, 4-28, 4-20, 4-21. Estimates assume expected diversion to autos following abandonment of SP service

3. <u>User Cost Savings Related to the Program</u>

Based solely on the value of the discounts on the reduced fare commuter tickets sold, user cost savings attributable to the Fare Stabilization Program were substantial. Sam Trans had estimated that the discount fare plan would save $11.00 to $16.00/month for monthly rail ticket purchasers in San Mateo County. The value of fare discounts was $535,692 in 1978 (an average of $44,641 per month), $694,904 in 1979 (about $57,950/month), and about $347,452 in the first six months of 1980, for a total user cost saving of $1,578,048 in San Mateo County alone.

4. <u>Effectiveness of Marketing Strategies</u>

Although several of SamTrans' programs to market rail service concurrent with the Fare Stabilization Program apparently had little direct effect on increasing ridership, based on limited data, it appears that awareness of the SP service as a transit alternative was increased by the fare discount program itself and by informal relatively low cost marketing efforts. The ridership survey conducted by Caltrans in March 1980 found that of the 3,221 riders who began riding during the period between January 1978 and March 1980, 64 percent found out about the SP service through "word of mouth." Only about 5 percent mentioned information provided by local transit agencies, and about 3 percent cited the Caltrans/SP/Muni brochure or information provided by employers. Less than 3 percent of all respondents mentioned newspaper ads, radio spots, or freeway billboards.

Other efforts to increase rail ridership met with mixed results. SamTrans' policy of free bus transportation for commuter ticket holders did not greatly increase the share of station access trips made by bus. In SP's ridership survey of December 1977, 4.1 percent of rail passengers arrived at the station by bus. In Caltrans survey of March 1980, this share rose to 6.4 percent.[1] This modest increase and the relatively small percentage of commuters using buses for station access is attributable to several factors. Most commuters (80 percent) have access to a car and live within 3 to 5 miles of a station. Because bus routes (particularly east-west routes) generally attempt to serve dispersed residential and commercial areas as well as railroad stations, routes to stations are often circuitous and slow, making driving to the station more attractive. Parking costs ($.25/day) are low, and since several large commuter stops (e.g., California Avenue, Atherton, and Hayward Park) provide little shelter from rain or cold weather, autos perform this function.

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[1]Caltrans, 1981, p. 31; and

V. CONCLUSION

SamTrans' Southern Pacific Fare Stabilization Program was successful in achieving its major objective of stabilizing commuter rail ridership in 1978 despite the 25 percent fare increase of August 1977. On the basis of yearly ticket sales data, commuter rides increased 1.7 percent and total rides increased .5 percent between 1977 and 1978. This small increase (actually stabilization) of ridership is significant because long-term ridership trends based on ticket sales data predicted a decrease of 6 to 8 percent in total rides over the 1977-1978 period. Passenger count data collected in October 1977 and October 1978 indicates a patronage increase of 1.4 to 2.2 percent, even though a decline of about 4 percent was expected based on passenger counts over the 1967-1977 period.

These small increases in ridership correspond roughly with rising corridor travel volume during the 1977-1980 period (based on ADTs for major highways in the region, corridor travel increased 5 to 7 percent between 1977 and 1980). This correlation is further evidence that the Fare Stabilization Program held the rail share of corridor travel (which had been declining since the 1940's) constant, even after the 1977 fare increase. While some portion of the ridership increase can be explained by a shift of single ticket buyers to discounted commuter tickets, the overall increase in commuter ridership far exceeds the decrease in one-way and round trip tickets sold, resulting in a net increase in total rides. Since the total ridership increase resulted solely from higher sales of commuter tickets, which were the only tickets discounted, it is reasonable to attribute the 1977-1978 ridership increase to the Fare Stabilization Program.

After March 1979, the impact of gasoline shortages and rapid price increases during 1979-1980 make determination of program impact on ridership difficult. While total ridership has declined 5 percent and commuter rides 10 percent since the program ended in August of 1980, patronage is still 35 percent above 1977 levels.

Although Caltrans' ridership survey of March 1980 found that various marketing programs (including radio and newspaper ads) had little impact on increasing ridership, it appears that the discount program itself, along with SamTrans' efforts to register people for the discount and favorable media coverage, were important in developing awareness of rail service as a low cost alternative to driving.

The program had little impact on reducing VMT, traffic congestion, energy use, or vehicular emissions, mainly because rail trips are a very small proportion (3 to 4 percent) of total trips between Peninsula locations and San Francisco, and the diversion of auto trips attributable to the program, though indeterminate, was certainly very small. It was also criticized (to some extent fairly) as inequitable since only commuter tickets were subsidized. However, the main purpose of the program was to stabilize rail ridership to generate support for service improvements and prevent abandonment of the service. The ultimate goal was preservation and improvement of an existing transportation system, providing enhanced regional mobility at relatively low cost, and with minimal disruption of the environment, in contrast to other alternatives (i.e., BART extension).

The Fare Stabilization Program, although a temporary project which lasted for less than three years, demonstrated that ridership on the Southern Pacific commuter line could be increased with relatively inexpensive marketing efforts, even in the absence of major service improvements. The success of the program in attracting riders and reversing the long term ridership decline was undeniably an important factor in motivating the Southern Pacific Transportation Company to negotiate a long-term purchase of service contract with Caltrans in May 1980. This agreement, which replaced the program's user-side subsidies with a direct subsidy to the railroad, ensured continuation of the Peninsula rail service, and encouraged State and Federal agencies to initiate a program of equipment modernization and service improvements.

X. CONCORD, CALIFORNIA BUS SIGNAL PRIORITY SYSTEM

I. BRIEF DESCRIPTION

The traffic signal priority system (Opticom) for buses on the Willow Pass Corridor in Concord, California was intended to reduce delay to local buses in a suburban shopping center district with high traffic congestion, about 35,000 vehicles daily. The system, instituted from April 1978 to May 1980, applied to twelve intersections along the 3.5 mile arterial corridor, on or parallel to Willow Pass Road, a four-lane suburban arterial. Agencies involved in this project included the City of Concord Department of Public Works, Alameda-Contra Costa Transit District, Metropolitan Transportation Commission, California Department of Transportation.

For two years Concord, California, a low density satellite city of 100,000, operated a bus signal priority system along the Willow Pass Corridor, a 3.5 mile corridor between a regional shopping center and the Concord BART Station. The system, required because of bus time lost to traffic congestion, was installed with the help of grant funding through the Metropolitan Transportation Commission using state and regional funds. It consisted of fixed beam detectors and phase selectors at each traffic signal. This apparatus could be triggered to provide signal priority to buses if the latter were equipped with emitters to signal their approach. Four bus routes, three of them contracted for by the City of Concord, and one of them contracted for by the Bay Area Rapid Transit District, used the system.

However, some problems developed. Because of the small number and vulnerability of the emitter-equipped buses, the transit operator was unable to dispatch enough emitter-equipped buses on these four routes. Also the City, which has been growing rapidly in population and in traffic, had to do major construction work at some intersections. This temporarily caused the priority system to be turned off at those intersections and the signals and priority apparatus to be modified. In the spring of 1980 the City installed a new, citywide, computer-run traffic signal system. This new system permitted only bus preemption - automatic and immediate green time for approaching buses - as opposed to the existing bus priority system - safer speeding or slowing of the normal signal sequence rather than immediate interruption. As preemption was considered too dangerous and as major construction work and the lack of emitter-equipped buses were negating the system anyway, it was turned off. There are now plans to reactivate it, pending modifications to the citywide traffic signal system.

II. BACKGROUND TO THE PROJECT

Concord, California, which lies twenty-five miles east of San Francisco in Contra Costa County (see Map X-1), is a typical small Sun Belt city. Its population has grown substantially since the Second World War. In 1940, only 1,373 people lived in Concord. By 1960 this was 36,000 and by 1970, 85,000. Between 1970 and 1980 while San Francisco's population declined, Concord's population grew 25 percent to 105,000. The number of vehicles registered in Concord has grown even faster --from 55,950 in 1970 to 91,850 in 1979. The average number of vehicles per household grew from 1.95 to 2.67 in this period.[1] Most suburban areas in California have also seen great population growth, however, Concord's growth has been characterized by two important factors atypical of other suburbs: 1) it has been the terminus of a Bay Area Rapid Transit (BART) line to Oakland and San Francisco since 1972 and hence a commuting center, and 2) it is becoming an important satellite city and is undergoing a great increase in business firms relocating there, resulting in much new commercial building construction including a trend to high-rise office buildings.

There are proposals before the City of Concord presently for eight new office buildings, all between four and ten stories high. Such vertical development, the mark of a real CBD, would have been "unheard of ten years ago" in suburban Concord, according to one local official. However, further horizontal development of the city is blocked by mountains, Suisun Bay and the Concord Naval Weapons Station at Port Chicago, an ammunition storage area. Concord city planners predict the following increases in land use from 1979 to 1995: office 250 percent, commercial 100 percent, industrial 42 percent, and residential 28 percent. Figure X-1 shows Concord's projected growth. The planners also note that the lion's share of this construction will take place in a central area bounded by Contra Costa Boulevard on the west, Monument Boulevard on the southeast, San Carlos and Port Chicago Highway on the east, and Solano Way on the north (see Map X-2).[2] This area, possibly the future CBD for Central Contra Costa County, is mostly west of what is now Concord's low density downtown, an area north and west of the BART station.

The Central Business District, when fully developed, will be spread out over a large area. This makes transit service

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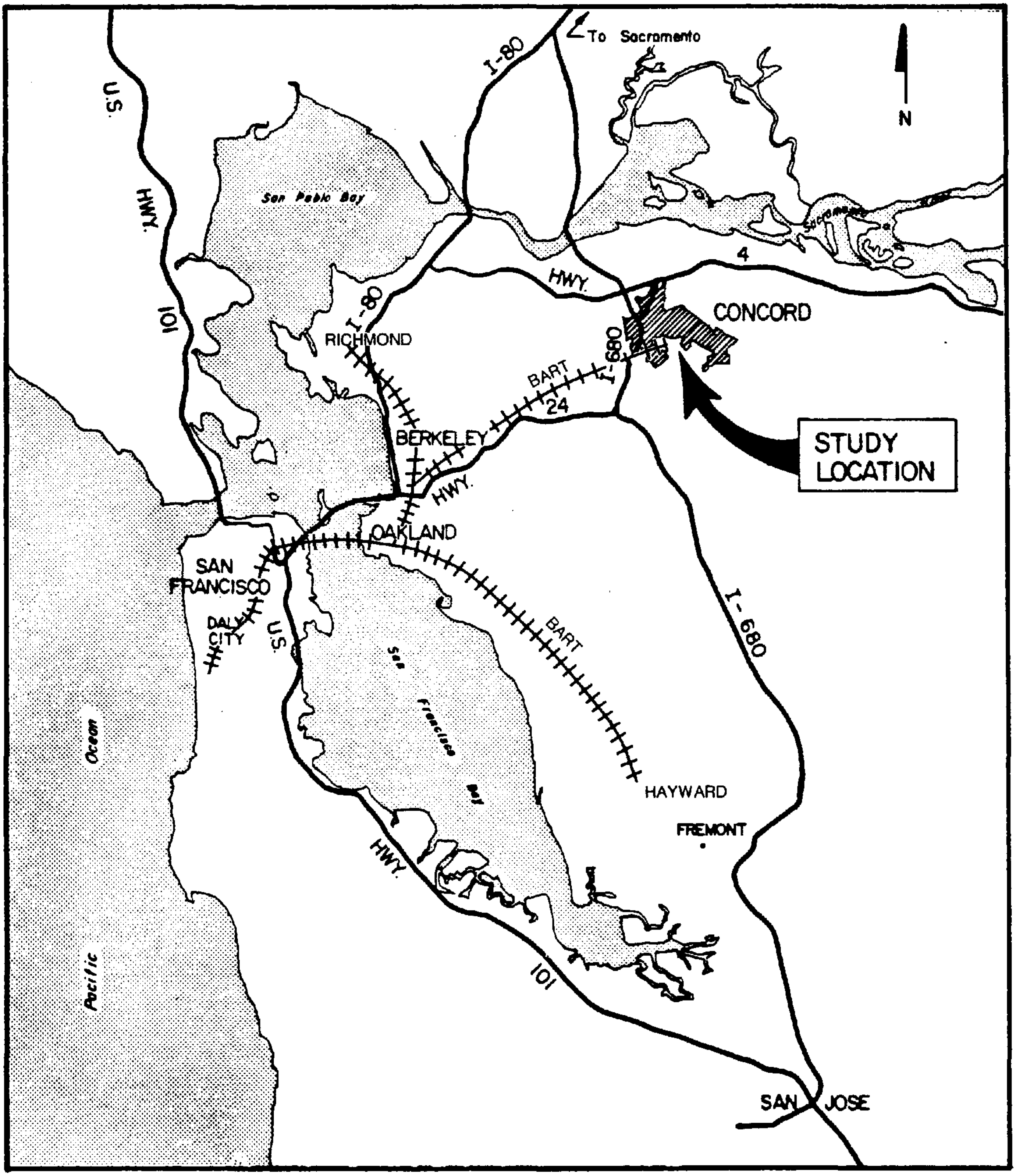
[1] Ted Moss, City of Concord Traffic Operations.

[2] Page 8, Planning and Public Works Departments, City of Concord, Citywide Transportation Study and Recommended Amendments to the General Plan, February 1981 (hereafter: Citywide Transportation Study).



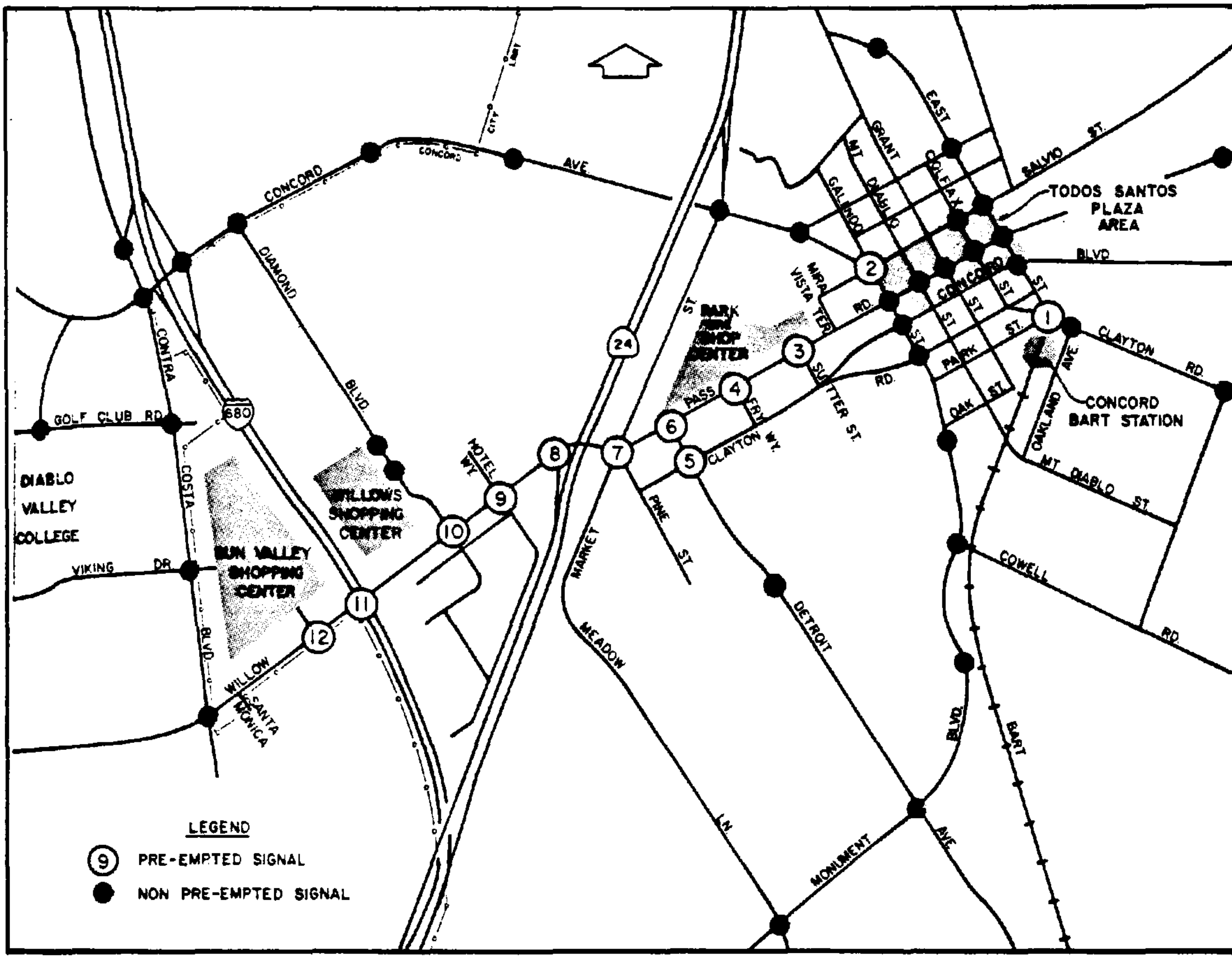
MAP X-1: LOCATION MAP

FIGURE X-1: CITY PROJECTIONS OF CONCORD GROWTH

Listing	1967	1980	(Wilbur Smith Study) 1990	(DKS Study) 1995
Population (est.)	81,000	100,000	197,000	134,000[1]
Housing units	25,000	40,000	53,000	51,000
Employees	14,000	---	33,000	---
Commercial (sq. ft.)	3 million	5 million	9 million	10 million
Office Use (sq. ft.)	200,000	1.4 million	500,000	5 million
Registered Vehicles	47,500	95,000	---	150,000[2]
Approx. Number of Trips per day	191,000	320,000	410,000	427,000
Injury Accidents	398	779 (est.)	---	1,200[3]
Rate (per 1,000 Registered Vehicles)	8.7	8.2	---	8.0

[1] Based on existing ratio of persons per household.
[2] Based on existing ratio of vehicles per household.
[3] Based on projected rate of 8.0 injury accidents per 1,000 registered vehicles.

SOURCE: Citywide Transportation Study. Population, housing, employment, land use, vehicle registration and accident projections were all made by City staff for these studies. Trip generation projections were made by the consultants listed above.



	LOCATION	PRE-EMPTED PHASE
①	CLAYTON, PARK & EAST	PARK-EB
②	SALVIO, CONCORD & GALINDO	SALVIO-EB, WB
③	WILLOW PASS & SUTTER	WILLOW PASS-EB, WB
④	WILLOW PASS & FRY	WILLOW PASS-EB, WB-LEFT TURN FRY-NB
⑤	CLAYTON & DETROIT	CLAYTON-EB
⑥	WILLOW PASS & DETROIT	DETROIT-NB WILLOW PASS-EB
⑦	WILLOW PASS & MARKET	MARKET-EB, WB
⑧	WILLOW PASS & HWY 24 ON-RAMP	WILLOW PASS-EB
⑨	WILLOW PASS & HOTEL	WILLOW PASS-EB, WB
⑩	WILLOW PASS & DIAMOND	DIAMOND-SB-LEFT TURN WILLOW PASS-EB, WB
⑪	WILLOW PASS & HWY 680	WILLOW PASS-EB, WB
⑫	WILLOW PASS & SUN VALLEY	WILLOW PASS-EB, WB

Map X- 2: WILLOW PASS CORRIDOR

difficult. For point-to-point travel within the CBD, and generally within the city, the automobile has and will continue to have a significant travel time advantage over bus service. What the local bus system can do most competitively is to deliver passengers to BART and, to a lesser extent, it can provide access to some locations downtown from residential neighborhoods which have nearby bus service.

However, the City has done a great deal to encourage mass transit use and would like to shift as much of the projected traffic growth as possible to transit and car pooling to avoid impending rush hour traffic saturation. Since 1965, traffic has increased 67 percent, and is expected to increase 33 percent between 1979 and 1995 (from 320,000 trips per day to 427,000 trips per day). To meet this large projected increase the City has an ambitious General Plan to widen existing streets and avenues and construct more. Large scale intersection improvements are presently taking place in the City and have been for several years.

The Concord bus signal priority system along the Willow Pass Road Corridor, begun in April 1977, has been one attempt by the City to encourage a modal diversion to transit. Realizing the inherent travel time advantage of private vehicles over public transportation, the City sought to provide buses with a travel time advantage for their linehaul movement.

Willow Pass Road and parallel streets are the major traffic corridor in the burgeoning central area of Concord, near the Sun Valley regional shopping center. Traffic is heavy along Willow Pass Road. At the western end of the effected portion of Willow Pass Road, near the Sun Valley regional shopping center, average weekday traffic volumes were 32,800 in 1977, before the priority system began, and 34,600 in 1980 when the system was discontinued (see Map X-3). Volumes east of this point have been lower as some traffic can divert to paralleling Clayton Road but total east-west traffic along this corridor is roughly the same throughout--about 35,000. Traffic is projected to grow to 50,000 daily by 1995.[1] The Concord bus priority system along the Willow Pass Corridor was intended to free buses from the existing and projected traffic congestion.

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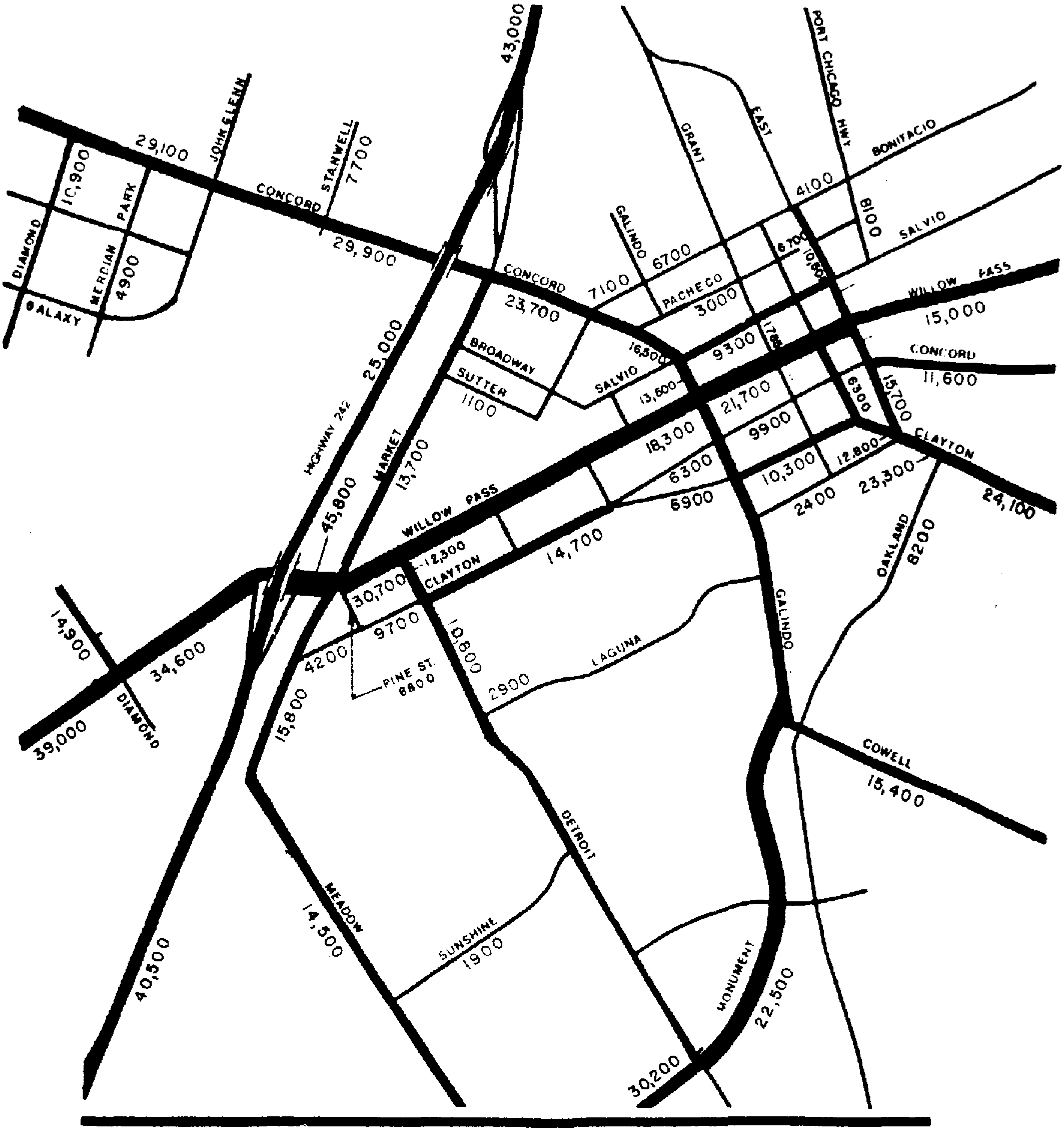
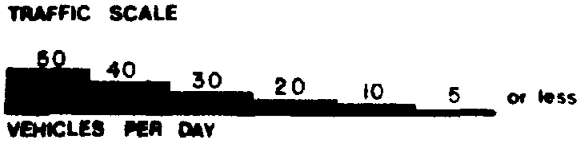
[1]Page 11, Citywide Transportation Study.



MAP V-3: CENTRAL AREA TRAFFIC VOLUMES - 1980



III. PROJECT PLANNING

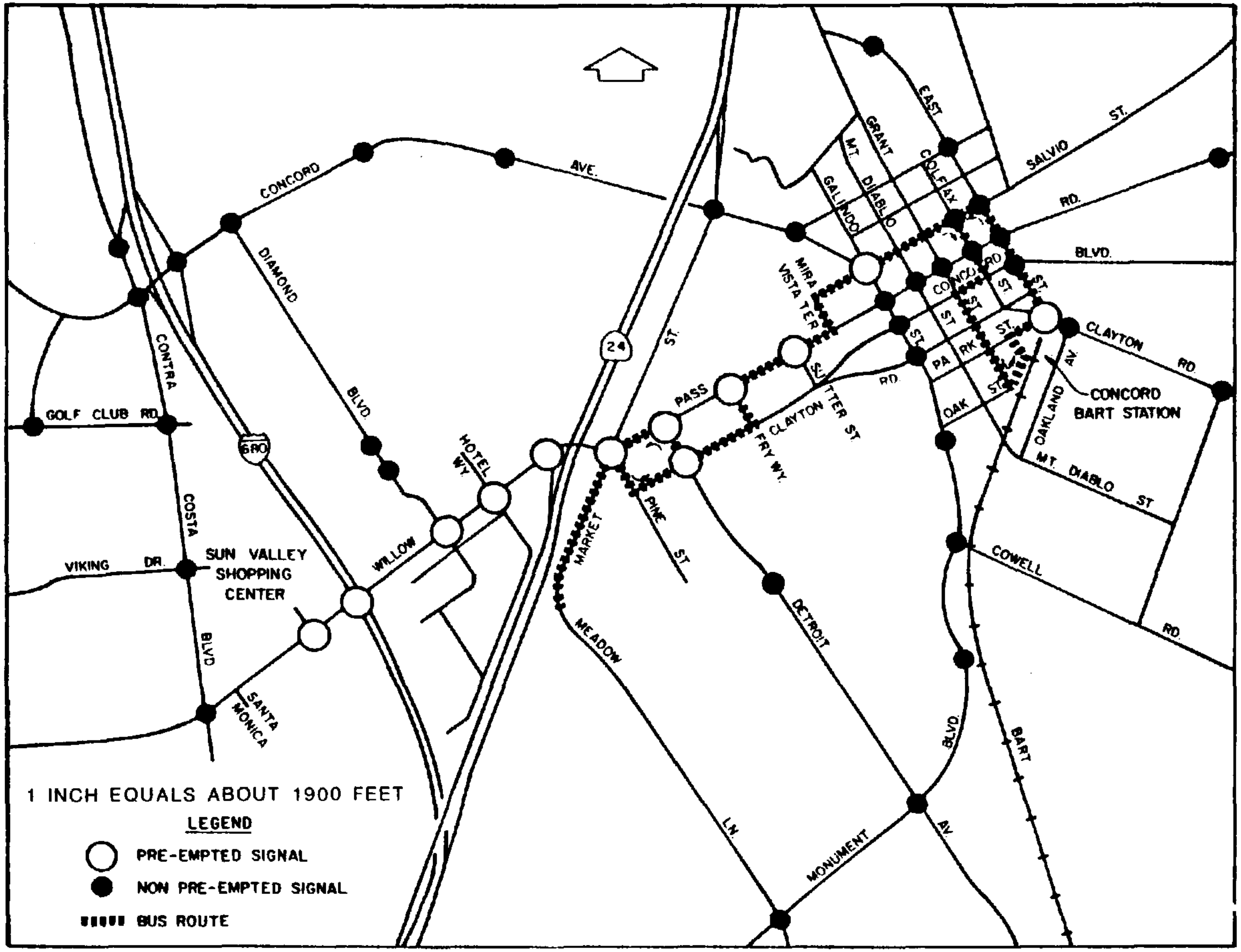
Four bus routes (see Maps X-4, X-5, and X-6) which ran along the congested Willow Pass Corridor, between the Sun Valley shopping center and the Concord BART Station, were falling so far behind schedule that additional buses and drivers had to be used to maintain the schedule headway. Additional buses for peak period service had to layover between morning and evening rush hours anyway in Concord because of the time involved moving them between Concord and their garage at Emeryville, near Oakland. This problem was most severe during the Christmas shopping season in November and December, effecting Saturday operations as well as weekdays. The routes effected were the 303A, 306W and 307 (City-contracted) and the "M" (BART- contracted). The operator in all cases was the Alameda-Contra Costa Transit District (AC Transit). All routes served the Concord BART Station and ran weekdays, the first two operating on Saturday as well.

The City of Concord was concerned about the delay to the bus routes it was subsidizing, especially because: 1) the buses going off schedule were destroying the timed bus transfer system at the BART Station, and the City's objective to build non-captive transit ridership; and 2) a reliable bus service was needed to serve BART commuters, who experience severe parking shortage at the BART Station.

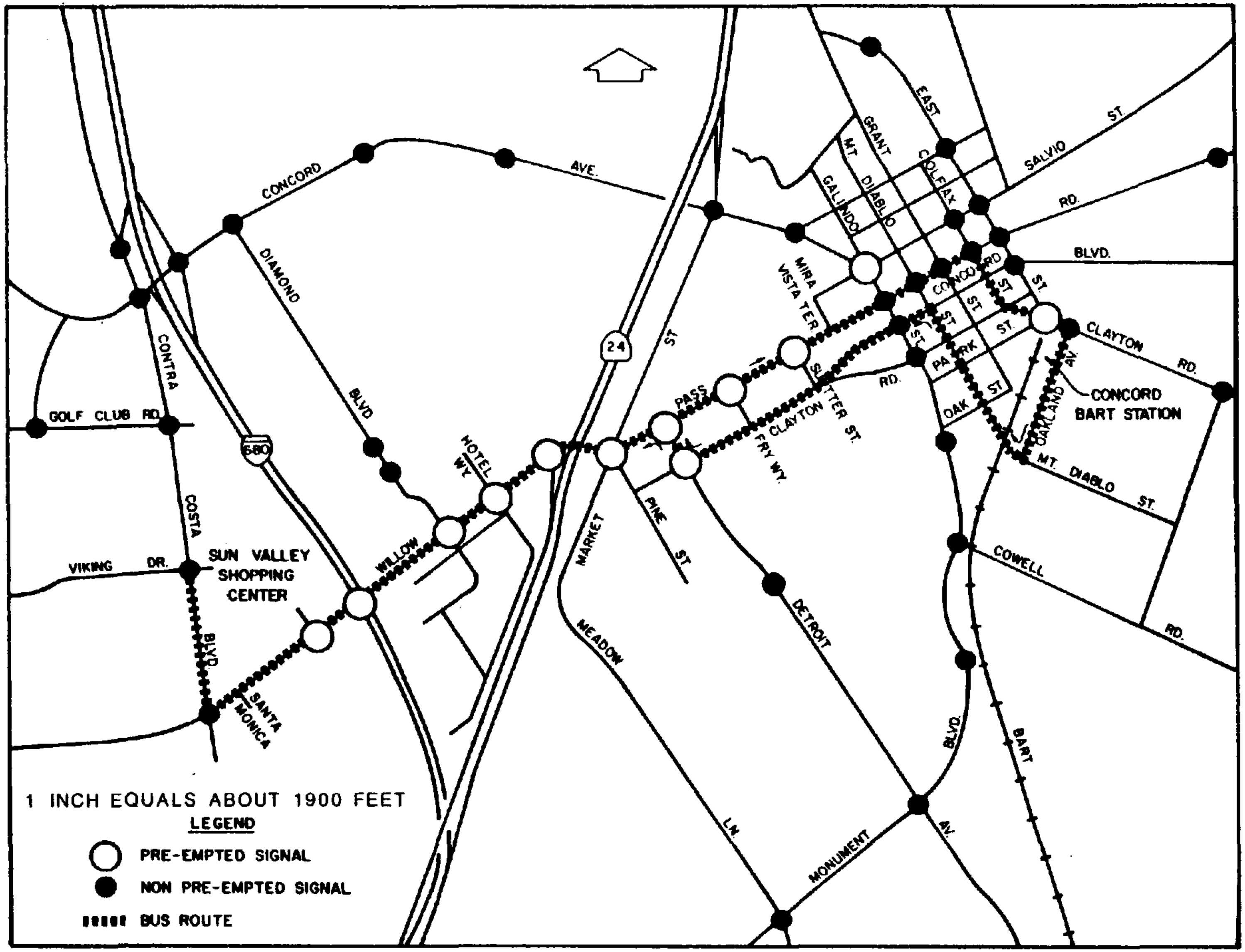
The BART Station Parking Problem

Parking at the Concord BART parking lot (1,076 spaces) was used to capacity almost from the day BART service to San Francisco opened. About 500 additional parking spaces have been obtained at leased annex lots near the Station but this is still insufficient to meet the demand. By 1980, an estimated 800 BART commuters were parking on residential streets in the vicinity of the Station.

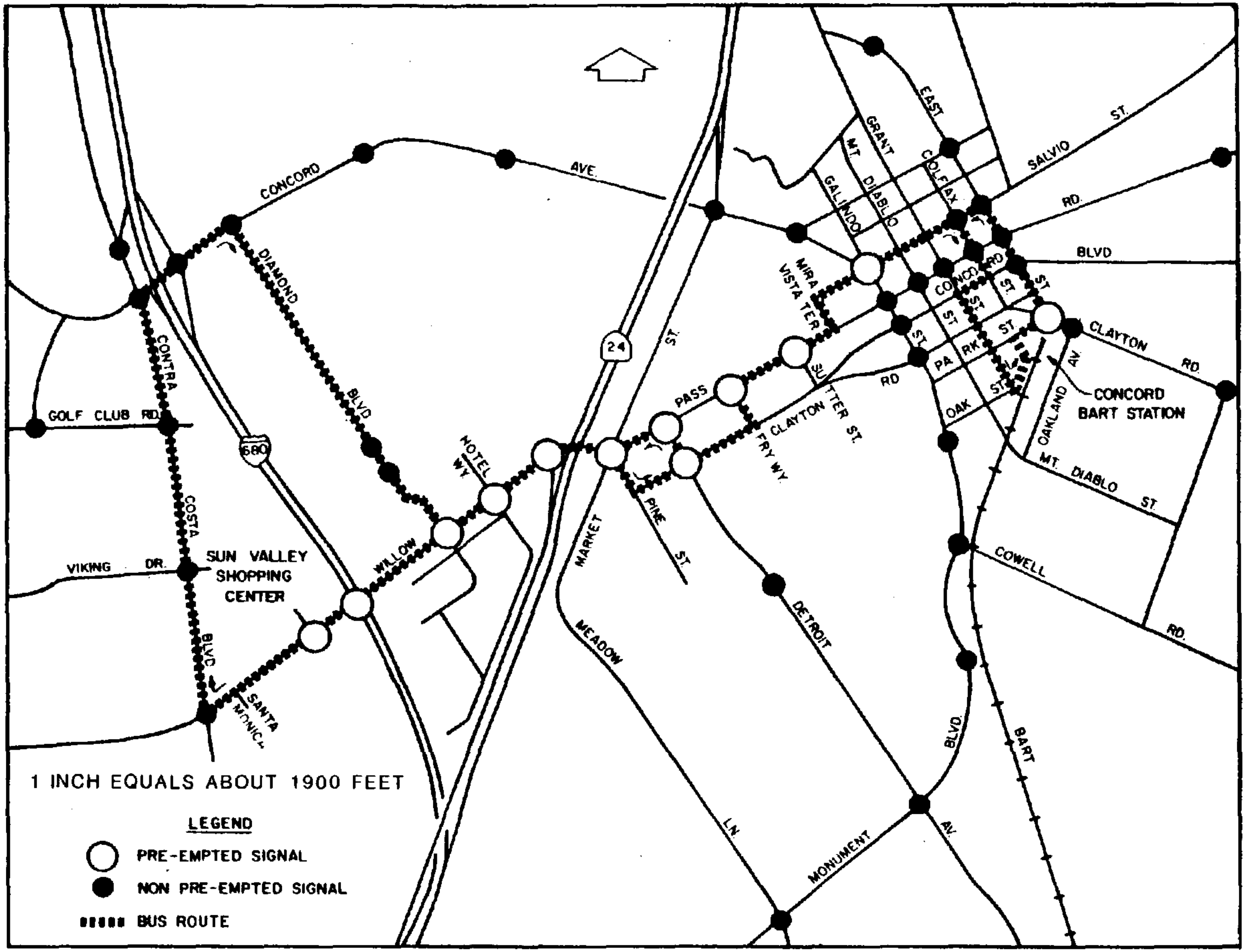
This in turn led to a hostile neighborhood reaction against BART commuter parking on residential streets and the City's imposition, in January, 1981, of a residential parking permit program. This program is similar to the one adopted originally in Cambridge, Massachusetts and described in the Cambridge chapter of this report. It allows parking only for cars with stickers on them, indicating ownership by a neighborhood (not City) resident. The parking regulation is enforceable twenty-four hours a day. On nearby residential or business streets, there is either a 2- or 4-hour parking period and signs at the Terminal Shopping Center, east of the Station, warn that commuters' cars will be towed. In addition to the 100 percent utilization of BART's automobile parking lots, a site visit in September 1981 found about 90 percent occupancy at all bicycle and motorcycle spaces at the Station (100 bicycles, 30 motorcycles and 10 mopeds).



MAP X-4: STUDY ROUTE- BUS LINE 307



MAP X-5: STUDY ROUTE- BUS LINE M



MAP X-6: STUDY ROUTE- BUS LINES 306W & 303A

BART's responses to these parking problems and to the resident restrictive parking program has been, in the short term, to increase its bus feeder service--including the "M" line on Willow Pass Road, and in the long term, to build a $10 million multi-storied parking garage at the Concord Station and/or extend the BART line east to Antioch and open up another Concord BART Station near Highway 4 and the Port Chicago Highway. There is also space for some additional parking near the Concord Station on abandoned railroad right-of-way southwest of the Station and beneath the elevated tracks in what is now a park.[1] The Concord BART Station is the terminal for bus service in the Concord area. A Bus Only Street, with designated route stops, is located at the entrance to the Station. There are plans to move Greyhound (which has intercity service and what remains of its pre-BART commuter service) into the Station from its present site at the Park and Shop Center north of Willow Pass Road.

City Planning For Bus Priority

As traffic grew on the Willow Pass Corridor in the mid-1970's, City traffic engineers became increasingly concerned about the delay to buses and the negative implication of this for future transit ridership. They sought some way of giving buses priority over private automobiles to free them from the growing traffic congestion. With bus volumes less than 1 percent of overall traffic and with only four-lane roads to deal with, a bus lane was out of the question.

At about the same time, the 3M Company was developing its Opticom bus signal preemption system, which would allow buses to indicate their approach to traffic signals and cause the lights to change to green in the buses' direction. In the summer of 1975, the Opticom signal system was implemented for express buses at nine traffic signals on Greenback Lane, a 3.8-mile suburban arterial approaching Sacramento. After a three-month experimental period with two buses, the results of the Sacramento bus priority project were published, informing public agencies in California that the Opticom system worked well: "Bus trip time was reduced by an average of 23 percent; passengers benefited by a smoother, safer and more comfortable ride with increased schedule reliability," (see Figure X-2).[2]

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[1] Information on the Concord BART parking problem from: Ed Franzen, Traffic Engineer, City of Concord; Barbara Neustadter, Transportation Planner, Bay Area Rapid Transit District; Concord BART parking file at City of Concord Traffic Operations office; and survey of Station parking, September 1981, by M. Cunneen, Urbitran Associates.

[2] Page 1, Wilbur J. Elias, Division of Mass Transportation, California Department of Transportation, The Greenback Experiment - Signal Preemption For Express Buses: A Demonstration Project; April 26, 1976; Sacramento, California (hereafter: Greenback).

FIGURE X-2: EXPRESSSS BUS TRIP TIME ON GREENBACK LANE NEAR SACRAMENTO WITH & WITHOUT SIGNAL PRE-EMPTION

With Pre-Emption Westbound A.M.	Without Pre-Emption Westbound A.M.
5.28 Minutes	5.48 Minutes
5.47	5.55
5.63	6.18
5.78	6.43
5.80	6.65
6.17	7.17
5.68	6.25

9% Reduction with Pre-emption

With Pre-Emption Eastbound P.M.	Without Pre-Emption Eastbound P.M.
6.25 Minutes	8.73 Minutes
6.35	9.30
6.78	9.58
7.15	9.78
7.25	10.33
7.33	10.62
6.85	9.73

30% Reduction with Pre-emption

SOURCE: Greenback.

Based on the results of the Sacramento bus preemption system, Concord's traffic engineers applied for a grant to the Metropolitan Transportation Commission (the Bay Area's Metropolitan Planning Organization) to install and test the Opticom system on the Willow Pass Corridor. Prior to the grant application, the City in 1976 conducted a bus speed-and-delay study on three bus routes, operating the length of the Willow Pass Corridor from the Sun Valley Shopping Center to BART. This study, (Appendix A of this chapter) found that about 40 percent of all delay to buses was incurred at eleven signalized intersections. In submitting the study report and grant application to the MTC, the City's Traffic Engineer, estimated that given the existing level of pedestrian usage, an Opticom system at these eleven intersections would achieve at least a 25 percent decrease in overall delay on runs along the Willow Pass Corridor, saving an estimated 2.1 minutes per one-way run.[1]

The City's plan was to install the Opticom system at twelve of the sixteen intersections between the Sun Valley Shopping Center and the Concord BART Station (see Map X-2). Between these points the system would be used by the #303A, #306W and 'M' buses; in addition, for half the three-and-one-half mile route, the #307 buses also would use the system. Of the sixteen signalized intersections along the route, seven were part of Concord's downtown coordinated signal system while nine were independent, traffic-actuated signals. Opticom equipment would be installed at three of the coordinated signals and on all the nine independent signals and on eighteen AC Transit buses.[2]

The City's grant application to the MTC was intended to obtain funds to pay for the purchase and installation of Opticom equipment at twelve intersections and on eighteen buses and to have a "before" and "after" study of the system's performance be conducted by a local consulting firm. The Opticom system was installed between November, 1977 and March, 1978, and became operative April 3, 1977. The study of "before" conditions was conducted November 1-9, 1977; "after" conditions were surveyed May 15-25, 1978.[3] The "before" and "after" studies were to include precise on-board measurement of the

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[1]Letter, Richard Mitchell, Traffic Engineer, City of Concord, to Nat Gage, Metropolitan Transportation Commission; December 9, 1976; Concord, California.

[2]Internal Memorandum, Nat Gage to Grant Review and Allocations Committee, Metropolitan Transportation Commission; April 1, 1977; Berkeley, California.

[3]Page 10, TJKM Transportation Consultants, City of Concord Bus Signal Priority System Evaluation, for the City of Concord; June 30, 1978; Walnut Creek, California (hereafter: TJKM).

speed and delay to buses, floating car measurements of total traffic speed and delay, manually observed side street delay, accident reports, and timelapse photography. Involved in the study were the City of Concord, MTC, AC Transit, Caltrans, and the consultant, TJKM.

IV. PROJECT IMPLEMENTATION

A. The Opticom System

The Opticom system, as originally designed by 3M, consists of three parts:

1. A strobe light emitter mounted on the front roof of the bus, which flashes a brilliant, pulse-coded white and infra-red light beam;

2. a beam detector mounted on a pole at each signalized intersection - the detector picks up the strobe light beam given off by the emitter; and

3. a phase selector box installed in the traffic signal controller cabinet - when activated by the beam detector, the phase selector preempts the traffic signal progression, turning the lights green for the bus' approach.

The emitter's pulsating beam can be detected up to 1,200 feet from the beam detector. One modification to Opticom, requested by the California Highway Patrol first on the Sacramento Opticom system, was that the 250,000-candle power emitters be masked with opaque covers. These covers allow infrared light to pass through, but block out humanly visible light. They reduce the range (at which the emitter beam can be detected) by only 400 feet. This lens masking was done so that motorists would not confuse the buses with emergency vehicles at night. Flashing at eleven to fifteen pulses per second at durations of thirty microseconds, the emitter's beams were relatively subtle, and after the masking virtually invisible, even at night. Part of the reason for the Highway Patrol's request was that under California State law any traffic signal priority system has to grant first priority to emergency vehicles. For this reason, bus drivers were told to turn off their emitters and allow priority to any emergency vehicle. The Greenback Lane Opticom system near Sacramento was based on expanding a traffic signal preemption system for local fire trucks.[1]

In the process of designing and installing the Opticom system at the twelve Willow Pass Corridor intersections, the City of Concord engineers, working with 3M specialists, made a number of modifications to Opticom. These modifications revised the system from bus signal <u>preemption</u>, under which the lights would automatically turn green upon receiving the bus' emitter

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[1]Pages 5, 6, 17, Greenback; and "Computer Gives Buses the Green Signal," <u>Bus Fleet Owner</u>, August 1978.

signal, to bus priority, under which a number of safety "lock-out" features would prevent the traffic signal from automatically turning green in the middle of a pedestrian crossing phase or when cross street traffic was going across the intersection. A "call limit" timer was also put there to prevent a succession of buses from holding the traffic signal on green indefinitely to the detriment of cross street traffic and pedestrians.

Modifications to the Opticom system cost just over $10,000 to implement, but resulted in a number of devices which guaranteed safety and minimal disruption to vehicle and pedestrian cross flows. Under the resulting priority system, electronic impulses from the detectors trip the phase selectors (located inside the traffic signal cabinet) to either prolong a current green signal in the approaching bus' direction or accelerate the normal signal cycle so that the lights will turn green before the bus arrives at the intersection.

All signals have a maximum preempt green extension after which all other signal phases must be served before a new emitter signal and/or continuing signal (from a bus which has not yet cleared the intersection) can be received and serviced. In the case of preempt signals on conflicting phases, the first call received is processed and succeeding signals disregarded. If the signal is still present following one complete signal cycle, it is then processed. When a fully-actuated controller is preempted, phases with queued vehicles or pedestrians may be skipped prior to the preempted green phase; however, all phases are served immediately afterwards before another preempt cycle is begun. If a Phase A (arterial green) computer release pulse is received during a preempt operation, the information is stored to ensure termination of Phase A following preempt. Four of the fully actuated controllers had a "flow type" interconnection to provide upstream signal progression. This provided advance detection of buses at several locations, allowing signals in close proximity to clear simultaneously.

Under the modified Opticom system which Concord installed early in 1977, buses got preemption of signals about 60 percent of the time.[1] Because of the complexity of certain intersection traffic signals, each Opticom phase selector box had to be custom designed by the City and 3M. Signalization and approach widening changes at several of the intersections caused extensive re-modeling and re-setting of the selectors.

B. The "Before" and "After" Evaluation

Figure X-3 shows the "before" and "after" delay to the four bus lines and general traffic found by the consultant's study.

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[1]Pages 4 and 9, TJKM.

BUS LINE	NO. OF RUNS		AVG. TOTAL TIME (MIN.)		AVG. DELAY PER SIGNAL BEFORE (SEC.)		AVG. DELAY PER SIGNAL AFTER (SEC.)		AVG. DELAY PER RUN DUE TO TRAFFIC CONJESTION (SEC.)		AVG. DELAY PER RUN AT BUS STOPS (SEC.)		AVG. TOTAL DELAY PER RUN (SEC.)		AVG. NO. OF STOPS PER RUN	
	Before	After	Before	After	To Have Pre-empt	Without Pre-empt	With Pre-empt	Without Pre-empt	Before	After	Before	After	Before	After	Before	After
306W 303A	37	37	31.5	28.5	17.0	11.4	8.6	9.0	10.7	12.2	139.9	146.9	692.6	469.7	31.8	26.1
M	4	5	24.1	19.8	13.6	-	10.1	-	39	47	12	38	490	301	18	15
307	4	4	23.9	20.3	26.3	-	18.9	-	3.8	25.8	93.8	55.5	545.0	410.8	22	19
PASS. VEH.	10	10	19.29	19.01	23.7	-	22.9	-	0	39.9	-	-	469.5	493.5	16.5	14

Figure X-3: BUS "BEFORE" & "AFTER" SPEED & DELAY

On-Board Bus Speed and Delay

On-board bus speed and delay studies were conducted on all four bus lines that stop at the Concord BART Station and utilize the study corridor. Routes 306W and 303A were considered to be the best indicators of the effects of the priority system as they include all 12 equipped intersections. The two lines combined provided data for 31 round trips in both the "before" and "after" periods - enough to give valid statistical analysis. The average round trip travel time on these two lines was significantly[1] reduced by 9 percent, from 31 minutes 30 seconds to 28 minutes 30 seconds. Average delay at signals equipped with "Opticom" equipment was reduced by about 40 percent. The average delay at the signals which were not equipped with "Opticom" equipment was 13 percent less in the "after" period. To test whether the 40 percent reduction in delay that occurred at the priority signals (study signals) was significant, the average delay at the non-priority signals (control signals) was used as a controlling factor. During the "before" period, the delay per study signal was significantly higher than the delay per control signal. In the "after" period the delay per study signal was not significantly different from the delay per control signal. It is felt this significant improvement can be attributed to the bus priority system.

Due to the small sample size, the significance of the reductions that occurred on Lines 'M' and 307 was not tested; however, from Figure X-3 it is apparent that the reductions in average travel time (18 percent and 15 percent, respectively), and the reductions in average delay per signal with priority added (25 percent to 28 percent, respectively) were substantial. Also shown in Figure X-3 are the average delay per run due to general traffic congestion, the average delay per run accrued at bus stops, the average total delay per run and the average number of stops made per run. Notice that in all cases the number of stops decreased in the "after" period (significantly). When stops are decreased, operating costs and emissions should both decrease.

On-board speed and delay data was taken on Saturday for Line 303A for both the "before" and "after" periods. Although the comparisons showed impressively large reductions in total trip time and in delay at study signals in the "after" period; it was not certain, however, how much of the reduction could be attributed to the signal preemption system. During the "before" testing, which occurred at the beginning of the Christmas shopping season, there seemed to be unseasonally high

[1]Student's "t" test at a significance level of .05 was used to test the significance of any change in mean values between the "before" and "after" periods.

traffic volumes on Willow Pass Road and Contra Costa Boulevard, and delay due to traffic congestion was considered atypical for a Saturday afternoon. For these reasons the Saturday data was not used in any of the analyses.

Floating Car Speed and Delay

The auto speed and delay data was gathered using the floating car method to determine the impact that transit preemption had on the remaining vehicles in the traffic stream (buses constitute less than one percent of all vehicles on Willow Pass Road). The route traveled generally follows the path of bus routes 303A and 306W. Eleven of the twelve study signals are included on the route of the floating car analysis. Average round trip travel time and delay data are shown on Figure X-3. The travel time remained virtually unchanged (19.3 minutes "before" and 19.0 minutes "after). The slight decrease in delay per study signal was not significant (23.7 seconds "before" and 22.9 seconds "after").

Side Street Delay

To measure changes in the side street vehicular stopped time delay, delay data was taken at each study signal for those phases of the traffic signal not favored by the priority system. A total of 32 different traffic movements were studied. The mean stopped delay per vehicle for these movements in the "before" period was 28 seconds and in the "after" period was 30 seconds. This was not a significant increase.

Time Lapse Photography

Sixteen millimeter time-lapse films were taken at three major study signals for four hours each in the "before" and in the "after" periods at a cost of $1,300. The intent of taking the films was to verify the delay data taken and to identify any subtle adverse impact, such as motorist confusion, that might be missed in the other study procedures. The locations filmed were Willow Pass Road at Detroit Avenue looking eastbound; Willow Pass Road at Detroit Avenue looking westbound, which included westbound traffic backed up at Market Street; and Willow Pass Road at Hotel Way.

The films showed a noticeable reduction in delay for buses having priority emitters during the "after" study. At the Detroit Avenue and Willow Pass Road intersection, delay to buses northbound on Detroit was approximately one-third that experienced by other traffic. At Willow Pass Road at Hotel Way, no bus delay was observed during the "after" study, as compared to noticeable delays during the "before" study. Side street delay due to extension of main street green by buses did not appear to be excessive. No delays or backup of other vehicles were observed for more than one cycle length after passage of a bus. No motorist confusion or any new hazardous conditions appeared to be created by the preemption system. Some buses did not have emitters due to maintenance or scheduling problems, and there was noticeably more delay to these buses than to those with emitters.

Accidents

No safety evaluation of the project was possible because accident records do not note whether a bus involved in an accident was emitter-equipped or not, or whether the signal cycle hastening was the cause of the accident or if the Opticom system was operative. In the three-month Greenback Lane Opticom experiment near Sacramento, there were no bus-related traffic accidents,[1] nor were any recorded in the initial study phase in Concord.

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[1] Page 17, Greenback.

V. PROBLEMS ENCOUNTERED

Use of the Opticom system did result in a significant reduction in delay to emitter-equipped buses and an improvement in schedule adherence. However, a number of problems not directly related to the traffic signals or Opticom were encountered and these resulted in the interruption and eventual termination of the system.

Bus Scheduling of the emitter-equipped buses by AC Transit did not always work out. This was because of the high down time these buses incurred. Any malfunction of the emitter required the bus to continue without signal priority. The bus had to be driven back to the Emeryville yard at night and its emitter apparatus repaired the next day by radio technicians. In the morning while the bus was awaiting repair, a new bus without an emitter would be dispatched to Concord in its place. In addition, most of the original emitter-equipped buses were old and some were scrapped in the course of Opticom operation, while others were damaged. Other requirements of bus dispatching did not always permit AC Transit to have all of its few emitter-equipped buses operating on Willow Pass Corridor routes. AC's fleet is about 700 buses, which operate in the East Bay urban strip across the Bay from San Francisco - serving Oakland, Berkeley, Richmond, Piedmont, San Leandro, Fremont, Hayward, and neighboring communities.

Installation of Emitters on AC Transit's buses was more difficult than was foreseen. In order to install the emitters they had to be bolted on bus roofs and panels had to be pulled out and replaced to install the cables in the cab. Because of the extensive work involved, old buses "we were at liberty to demolish," as AC's Supervisor of Radio Technicians put it, were used. 3M's original, light bracket mountings were found to be too weak to stand up to the buses' vibrations and would fall off in the yard. Several emitters were also knocked off buses at low clearances at garage doors or bridges. AC Transit had to construct their own heavy 12-gauge steel brackets and backing plates. These were strong enough to peel off part of the roof if the emitter was hit by a low clearance. The remounting of Opticom emitters cost about $100 apiece. There were also problems getting emitter-equipped buses through the bus wash - mop heads got caught on the emitter and carried away and water sometimes leaked into the bus. Emitter components were knocked out by bus vibrations and sometimes overheated, however, sheathing the lights with a cast-aluminum housing ridged with heat sinks solved the latter problem.[1]

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[1]Ed Sheldon, AC Transit Supervisor of Radio Technicians, to Michael Cunneen, September 1981; and "Computer Gives Buses the Green Signal," Bus Fleet Owner, July 1978.

Maintenance Of Signals proved to be time-consuming and constituted about 90 percent of operational costs. Four intersections had construction work done on them in the subsequent two years after Opticom was installed and these signals and their Opticom phase selectors had to be modified.

Incompatibility Of Opticom with the new Multisonics computer-controlled, centralized City signal system ultimately ended the bus priority system. The City began installing the VMS 220 Multisonics system in the spring of 1980. The Multisonics system, while generally providing an efficient citywide controlling system for all traffic, had only a bus preemption module. This module, like Opticom originally, lacked the "lockout" and other safeguard features the City required. Multisonics had no limit on the number of preempted cycles so that lights could be kept green in one direction indefinitly and the preemption was automatic - even in the middle of a pedestrian "walk" phase or as cross street traffic had just begun to cross the intersection. By May 1980, with AC operating few emitter-equipped buses, with construction activities disrupting the Opticom system, and with the implementation of the Multisonics system without safety features, the bus priority detectors and phase controllers were turned off and have not been reactivated.

Aftermath of Project

Despite the fact that Concord's bus signal priority system is not now in operation, when it was operative it was found to be successful and led several other Northern California transit districts (Santa Clara County, Santa Cruz County and Sunnyvale) to install similar systems for buses and/or emergency vehicles. AC Transit sold several of the emitter-equipped buses formerly used on the Willow Pass Corridor to these other transit districts after the bus priority system was turned off in Concord. Many other Sunbelt cities--Houston, Miami and Louisville, for instance--have similar systems.

Both the City and the new Central Contra Costa Transit District, which is taking over bus operations in the Concord area from AC Transit, are seeking to reactivate the system by modifying the Multisonics computerized signal system. The AirBART Shuttle bus between Oakland International Airport and BART's Coliseum Station is emitter-equipped and has priority at four Opticom-installed intersections on its route.

Project Costs and Savings

The bus priority project's $126,125 capital costs and consultant evaluation were entirely paid for out of State and regional funds, without any Federal support. The Metropolitan Transportation Commission (MTC) drew on two sources: 1) the MTC Development Fund, a mixed-purpose fund based on county sales taxes; and 2) the Transit Development Act (TDA) funds from the State sales tax. The breakdown of these costs, as given by the City of Concord was:

1.	Signal controller equipment at twelve intersections fitted with receivers and phase selector equipment and eighteen emitting devices for the City of Concord's AC Transit contract buses	$106,500
2.	Installation of Signals	12,875
3.	Evaluation by Consultant	6,750

The project suffered a cost overrun of $45,000 because "needed modifications and custom design of preemption units for the City of Concord's controllers raised the cost over the original estimate developed by the City of Concord."[1]

Costs not included in the above figures would include about 1,200 hours of staff time by City of Concord personnel used to prepare contract documents, advertise, award the contract, furnish construction engineering and review time-lapse photography. Also AC Transit contributed much time in installing and repairing the emitters.[2]

Local officials believe a considerable amount of research and development costs must be borne, principally by Multisonics, before their computerized traffic signal system can be modified for Opticom-style bus priority again. The newly formed Central Contra Costa Transit District (CCCTD) is now applying to the Metropolitan Transportation Commission for a $30,000 TDA grant for Concord to make modifications so that the system can, at least partially, be reactivated. The proposal is now pending before the MTC's Grant Review and Application Committee. The new rolling stock of buses which CCCTD will purchase are intended to be emitter-equipped.[3]

It has been estimated that the bus priority system saved AC Transit at least $18,000 annually - the saving of an extra bus needed on Saturday to fill in for bus trips which were behind schedule due to traffic congestion. The problem of "lost trips" which required an additional bus and driver to

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[1]Letter, March 8, 1979, John T. P. Banuelos, Assistant Civil Engineer, City of Concord, to Sy Mouber, Coordinator of Special Projects, Metropolitan Transportation Commission.
[2]Page 9, TJKM; and Ed Sheldon.
[3]Robert Patrick, General Manager, Central Contra Costa Transit District, to M. Cunneen, September 1981.

fill in, was particularly severe in the Christmas shopping season in November and December - even on weekdays.[1]

[1]Letter, Gene Gardiner, Senior Transportation Planner, Alameda-Contra Costa Transit District (AC Transit) to John Banuelos, Assistant Civil Engineer, City of Concord; April 5, 1979; Oakland, California.

VI. CONCLUSIONS

The following conclusions about bus signal priority systems can be drawn from the experience of the one in Concord, California:

1. It reduces delay for buses at intersections.

2. The efectiveness of the system depends upon the ability of the operator to schedule emitter-equipped buses onto priority system routes.

3. Mechanical malfunctions can cause frequent breakdowns of equipment and require a good deal of maintenance.

4. If bus roof emitters are used, such emitter-equipped buses should not be scheduled along routes which have overhead clearance problems (bridge overpasses, etc.).

5. The system is subject to disruption when construction at prioritized intersections occurs.

6. Different signal systems may not be compatible with each other as in the case of the Opticom system and Multisonics.

7. Bus signal priority systems increase service reliability.

Bus priority, under which signal cycles are merely slowed or speeded but not interrupted, appears quite practical and safe as it minimizes the safety problems with bus preemption. A priority system can operate with higher bus volumes and with a low-to-moderate degree of crossflow. Such systems have been implemented on suburban arterials. If the number of buses or passengers on these arterials are relatively low, the cost/benefit ratios of such bus priority systems will also be low. Other applications would be where side streets with large bus or emergency vehicle volumes meet major arterials such as exits from hospitals, fire stations, or bus garages. In those circumstances, the priority system could move to grant green time to the side street and hold up the major flow of traffic.

To avoid costly retro-fitting these systems ought to come factory-installed with phase selector boxes in the traffic signal control cabinets and with emitters <u>in</u> not on buses to avoid clearance problems. In the future, it is hoped that counties and cities will be able to plan and purchase pre-designed and installed traffic signal systems with these devices, under central computer control or independently set or activated. These systems have application on many roads in suburban or low density urban areas.

The major lessons which can be learned from the Concord bus priority experience are that such priority systems can work well if applied where they are feasible and where the need exists. However, these systems require some fine tuning to ensure their proper operation.

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4. TJKM Transportation Consultants, City of Concord Bus Signal Priority System Evaluation, for the City of Concord; Walnut Creek, California, June 30, 1978.

5. "Computer Gives Buses the Green Signal," Bus Fleet Owner, August 1978.

6. Karen L. Paine, Traffic Control Devices Department, Minnesota Mining & Manufacturing (3M) Company, The "OPTICOM" Brand Bus Priority Signal System; Saint Paul, Minnesota, April 1977.

In addition the following individuals provided information, including extensive #419 Project files with the City of Concord Department of Public Works and TJKM Consultants; Richard Mitchell, former Concord Traffic Engineer and principal project organizer, and Frederick Dock, TJKM; Ed Franzen, Concord Traffic Engineer; T. C. Sutaria, Concord Traffic Operations Engineer; Steve Roberts, Concord Supervising Traffic Operations Engineer; Ted Moss, Concord Construction Inspector; Dave Weirich, Concord Engineering Technician; Ed Sheldon, Supervisor, Radio Technicians, AC Transit; Frank Johnson, Manager, AC Transit Emeryville Yard; Warren Robinson, AC Transit Scheduling Manager; Gene Gardiner, Senior Transportation Planner, AC Transit; Barbara Neustadter, Transportation Planner, Bay Area Rapid Transit District.

APPENDIX X-A

SUMMARY OF AVERAGE DELAY DATA
CITY OF CONCORD BUS SPEED AND DELAY SURVEY
Richard Mitchell, Concord Traffic Engineer

Concord City and BART Runs

August 26 - September 3, 1976

Route	Number of Runs	A	B	C	D	E	F
Lines 303A and 306A	(1) 8	29.8	934	765	618	423	45.3
Lines M-inbound and M-outbound	(2) 5 1/2	(3) 26.0	994	787	687	335	33.7
Weighted averages for all runs		28.0 (1695 seconds)	958	774	641	387	40.4

(1) Some figures included were based on 6 runs only, due to shuttle route deviations.

(2) One inbound trip omitted.

(3) Round trip time counted as sum outlined to D.V.C. plus inbound segment from Macy's stop back to BART Station.

A = Average trip time in minutes (round trip) - no layover time.

B = Average delay per trip due to all causes.

C = Average delay per trip due to traffic (excluding service stops).

D = Average delay per trip due to traffic signals.

E = Average delay per trip due to traffic signals in proposed pre-empt system.

F = Percentage, E/B x 100.

SUMMARY OF AVERAGE SPEED DATA

based on same runs as above

Route	Distance Round-Trip	Average Overall Speed	Average Running Speed	Estimated Overall Speed With Pre-empt System*
Lines 303A and 306A	7.0 miles	14.1 mph	29.5 mph	16.7 mph
Lines M-inbound & M-outbound	6.7 miles	15.5 mph	32.6 mph	17.8 mph

*based on delay reduction to average of 8 seconds per system signal.

The figures shown in the Summary of Average Speed Data were derived as follows:

1. Average Overall Speed = $\frac{\text{Round-trip distance}}{\text{Average trip time (Round-trip)}}$
2. Average Running Speed = $\frac{\text{Round-trip distance}}{\text{Average trip time - total delay}}$
3. Estimated Overall Speed with Pre-empt System = $\frac{\text{Round-trip distance}}{\text{Average trip time - time saved}}$

   where "time saved" = E - (8 x No. of pre-empt signals traversed in round-trip run)

With the number or pre-empt signals traversed being 18 and 16 on City (303A, 306A) lines and BART M-lines, respectively, "time saved" is estimated to be 279 seconds and 207 seconds per round-trip run for each of these respective lines. This is an average decrease in overall delay of 30% and 21%, respectively.

A weighted average for decrease in overall delay = 250 seconds, or 26%.

This is an average time saving of 4.2 minutes per run expected with the pre-empt system in operation. This represents a 15% improvement in average trip travel time.

Using a patronage level of 40 passengers per run, this translates into a total time saving of 168 minutes (including waiting time) or 2.4 person-hours per run. This may be expanded by the number of runs per year to an annual time saving of several thousand person-hours.

The above calculations and projections are based on average conditions. Potential improvement during peak hour traffic conditions is considerably greater. From the rather limited data collected, it appears that peak period round-trip travel times are approximately 25% greater than the average, or about 35 minutes rather than 28 minutes. Even with allowance for reduced running speeds during peak hour traffic, it is estimated that the pre-empt system would result in substantially greater improvement to travel time of buses during peak hours.

If it is assumed that running speeds are reduced by one-third during peak traffic conditions, running time will be increased by one-half, so that of the 7 minutes (or 420 seconds) added trip travel time, approximately 370 seconds is due to increased running time and 50 seconds to increased stopped time delay signals. If this 50 seconds is added to the potential "time saved", then a figure of 300 seconds, or 5.0 minutes, is arrived at as the approximate time saving per run during peak hour traffic conditions.

Thus it is estimated that the average and peak travel times under the proposed pre-empt system, compared to the existing, would be as follows:

ROUND-TRIP BUS TRAVEL TIMES (MINUTES) & IMPROVEMENT

	Present	Proposed	Improvement
Peak-hour traffic	35.0	30.0	5.0
Average traffic	28.0	23.8	4.2

The above analysis demonstrates that the time savings expected during average conditions would be exceeded by the expected during peak hours, even with allowance for increased running time due to peak-hour traffic congestion.

This means that the proposed system would insure a time savings of from four to five minutes per run during all hours of operation. This would provide for realistic adherance to schedules, with an operational margin of safety which is now lacking. Bus drivers must not press to maintain their schedule even under the most favorable conditions--often at the detriment of passenger comfort. Under unfavorable conditions, and during peak hours, the schedule cannot be met.

Rather than simply revise the schedule, the proposed system of traffic signal pre-empt devices is offered as an opportunity to improve level-of-service of transit as compared to automobile travel. At the same time, bus headways are such that the system will not have any appreciable effect on automobile driver delay.

DISCUSSION

The purpose of the bus travel time-delay study is to acquire a perspective on the existing travel times, the approximate amounts of delay encountered and for what reasons, and the degree of improvement to be expected as a result of the proposed pre-empt system. These figures, as presented in this report, are considered to be representative only and not precise measurements. They are intended to provide for an order-of-magnitude type of evaluation of the proposal.

For this reason, no attempt has been made to adhere to exactly comparable routes, and the BART (M-line) runs vary in "round-trip" time by several minutes (compared to Lines 303A-306A) due to this discrepancy in routes. The important variable was considered to be signal delay (especially at the proposed pre-empt locations) within any given run, compared to the total delay experienced on that (or similar) run. However, because of this, and the fact that "round-trips" have been artificially constructed for the M-line runs, these runs are shown separately on the Summary. It is apparent that the percentage delay due to signals is about the same in either case. Both BART and City busses would use nine of the eleven proposed pre--empt installations: therefore it is suggested that both groups of busses be equipped to actuate the pre-empt devices.

The figures shown in the Summary and Average Delay Data lead to the following conclusions:

1. Over 40% of <u>all</u> delay is due to proposed system signals.

2. An additional 264 seconds delay, or 27% of all delay, occurs at signals not included in the proposed sytem. (These include five Pleasant Hill - State signals, as well as ten additional interconnected signals in Concord.)

3. Total delay averages 57% of trip travel time.

4. Traffic delays account for more than 80% of total delay.

5. Signal delays account for 83% of traffic delays, or 67% of total delay.

6. A diagram of the composite of running time and delays due to all causes (making up average trip travel time) is shown below:

Average Trip Travel Time = 1695 Seconds (100%)

Avg. Running Time = 737 sec. (43.5%) Avg. Total Delay (all causes)=	950 sec. (56.5%)
Avg. delay due to traffic = (excluding service stops)	774 sec. (45.7%)
Avg. delay due to traffic signals =	641 sec. (37.8%)
Avg. delay due to signals proposed to be included in pre-empt system =	387 sec. (22.8%) or 40.4% of total delay

APPENDIX X-B

CONCORD POSITION ON LOCAL TRANSIT USE
From Citywide Transportation Study
Richard Mitchell, Concord Traffic Engineer

In undertaking the present study, emphasis on increased transit usage was considered of high importance. The use of transit may forestall or eliminte the need for costly street improvements in some corridors. However, it was determined that even if transit usage were to increase ten-fold over what it is today, it would not eliminate the need for physical improvements on the General Plan street system. This is due both to the low present rate of usage (about 3,000 trips per day - less than 1 percent of the City's total trips), and to the large projected increase in travel expected in the City by 1995. Assuming that local transit system improvements could attract ten times the ridership (or 30,000 trips per day) that would represent only 7 percent of the total trips to be made within the City by 1995. Based on the experience of other communities in Northern California, staff believes that 5 percent of overall trips is the most that can be realistically be expected. However, it should be possible to capture 10 percent of trips in certain heavily-traveled corrdiors such as Clayton Road.

With increases of 25 percent to 50 percent projected on many major streets, it may readily be seen that reliance on transit will not eliminate the need for street improvements altogether.

Many factors enter into a comparison of transit costs versus privte auto costs (which frequently tend to be "hidden" or understated). However, it is possible to estimate the out-of-pocket public costs necessary to reduce vehicular traffic volume by a given amount in a given corridor through the addition of buses (assuming buses are sufficiently convenient to attract riders).

To eliminate one lane of vehcicular traffic at peak hour (600 vehicles), it would take about 15 buses per hour operating in the same direction.

At the current contractual rate, bus service costs approximately $40 per bus-hour. Thus, the cost for eliminating the need for one lane in each direction (600 vehicles per lane x 1.1 person per vehicle = 660 persons per lane) using 15 buses (carrying an average of 44 persons per bus) would be on the order of $600 per hour or about $1800 per peak period. This translates to $460,000 per year.

The same annual amounts if used to finance a long-term bond issue* would fund a street construction project of about $5 million. Thus it appears "economical" to use transit to avoid street construction for added lanes, if the annual cost is on the order of 10 percent or less of the cost of street construction and maintenance.

For reasons of land use as well as economy, it is suggested that the transit corridor may be appropriate. Clayton Road has a concentration of commercial, office, and higher-density residential uses that could increase potential transit usage. The alternative would be to provide additional traffic capacity either on Clayton Road or on parallel routes, such as Concord Boulevard and Cowell Road. This would be extremely expensive and disruptive to present land uses on these streets.

The criteria developed above were used to evaluate increased transit service in a specific corridor - Clayton Road - to determine if annual expenditure(s) on the order of $500,000 or less could eliminate the need for street construction project(s) on the order of $5 million or more, in this particular corridor, assuming 10 percent of all trips carried by transit.

The Clayton Road corridor has potential for improved transit service to attract auto drivers out of their cars and into a bus, thus reducing congestion at major intersections and avoiding the need for widening beyond the 6 lanes now shown on the City's General Plan.

The concept of using short headway bus service (with buses every 5 minutes along Clayton Road, every 10 minutes in the neighborhoods, and every 20 minutes in the Clayton area) was studied. A goal of serving 10 percent of the total trips in the corridor was assumed for such a system.

The corridor was divided into 4 areas and the trip generation zones and data from the master traffic study were used. See map (Figure No. 11). Many traffic zones are served by the Concord Boulevard and Cowell Road bus routes in addition to the Clayton Road route. These zones were divided half way between routes to approximate passenger walking distances of 1/4 mile.

The resuls are summarized in the following table:

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*Example based on 27-year bonds at 8.75% interest rate.

Item	Existing Service	10% Existing Trips	10% Future Trips
Buses	2	11	15
Annual Cost	$200,000	$1,500,000	$2,000,000
Passengers per hour peak period	120	670	1,000
Passengers per hour midday	100	570	860

The proposed bus service on Clayton Road would permit the planned 6-lane street to operate at an approximate "C" level of service. The demand for additional parking at the BART Station would also be reduced by the short headway bus service and the satellite parking lot on Bailey Road.

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